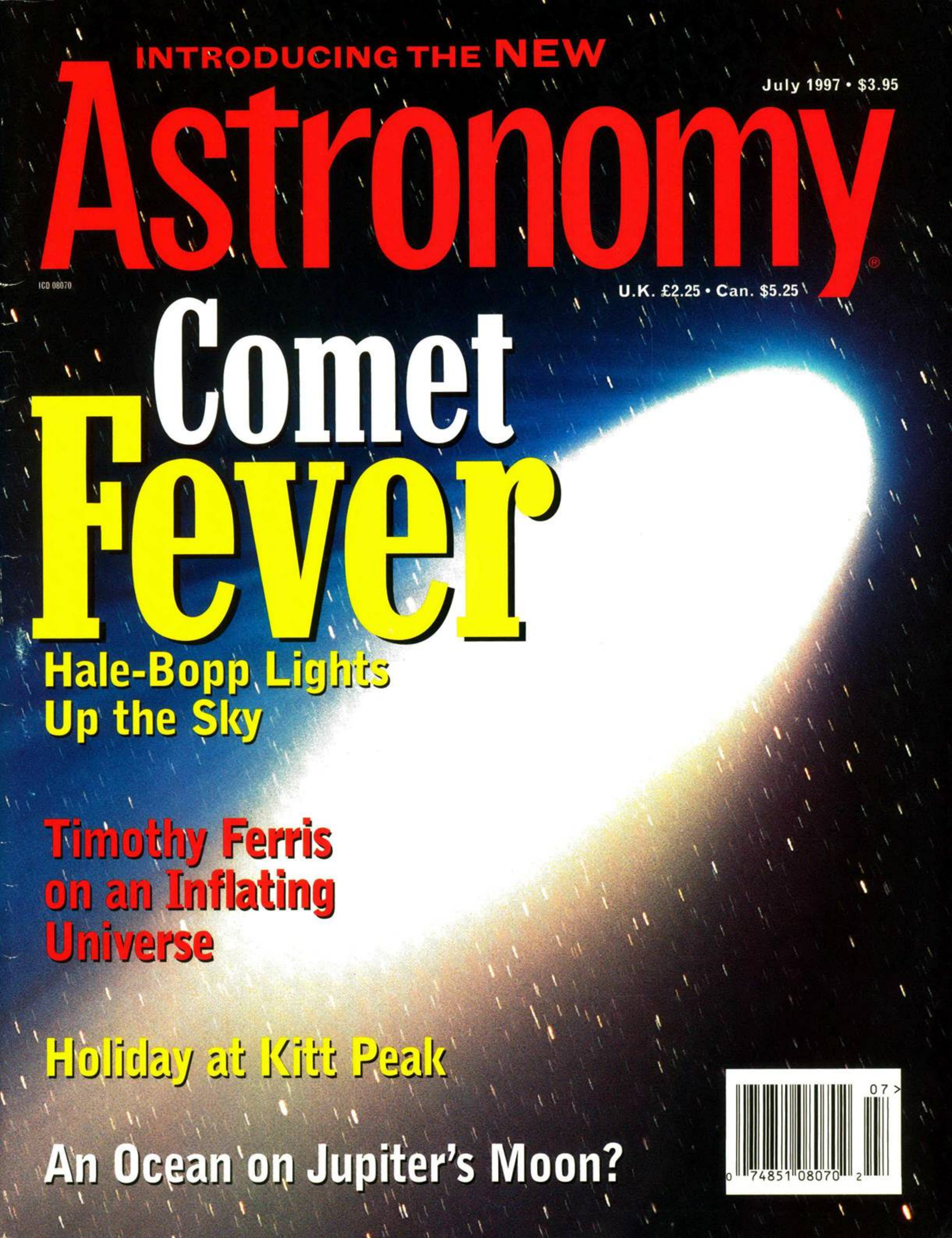


INTRODUCING THE NEW

Astronomy®

July 1997 • $3.95

U.K. £2.25 • Can. $5.25

ICD 08070

Comet Fever

Hale-Bopp Lights Up the Sky

Timothy Ferris on an Inflating Universe

Holiday at Kitt Peak

An Ocean on Jupiter's Moon?

07 >

0 74851 08070 2

LX50

Advanced technology at the most affordable prices *ever.*

■ **Battery-Powered, Completely Cordless Operation!** Meade LX50 models operate for more than 50 hours from six AA-size batteries inserted through the telescope's control panel. Or use the standard-equipment 25 ft. cord to power the telescope directly from any auto cigarette lighter plug.

■ **Standard-Equipment Declination Motor and Hand Controller:** Plug the hand controller into the LX50 control panel and you're ready for full dual-axis drive capability at any of 4 photo-guide or microslew speeds: 2x, 8x, 16x, or 32x, plus quartz-controlled sidereal-rate tracking in R.A. Switch speeds instantly using the speed-control button on the hand controller. Dual-axis drive rate is indicated by a red LED.

■ **Multi-Function Control Panel:** Includes connectors for CCD autoguiders; for the standard-equipment Declination motor; and for the optional Magellan II Computer-Corrector *(below)*. A North-South switch permits telescope operation anywhere in the world.

■ **Super Multi-Coated Optics:** The exact same EMC super multi-coated optical tube assemblies included with Meade LX200 models.

■ **Massive LX200-type Fork Mounts:** Meade LX50 mounts are manufactured of the same virgin aluminum castings as Meade LX200 Schmidt-Cassegrains. Massive, rigid mountings that include the Meade LX worm-gear drive system with low periodic error for advanced photographic or CCD imaging applications. *No competing mid-priced equatorial mountings even come close.*

SPECIFICATIONS: 7", 8", and 10" LX50's—Each complete telescope includes 8" or 10" f/10 Schmidt-Cassegrain or 7" f/15 Maksutov-Cassegrain optical tube assembly with EMC super multi-coatings; heavy-duty LX200-type fork mount; 5.75" LX worm gear system in R.A.; multi-function control panel; DC servo Declination motor; manual and electric slow-motion controls on both axes; setting circles on both axes; keypad hand controller; 4-speed drive controls on both axes; battery compartment accepting six (user-supplied) AA-size batteries; 25 ft. power cord for telescope operation from 12v. auto cigarette lighter plug; 6 x 30mm (7" and 8" models) or 8 x 50mm (10") viewfinder; 1.25" diagonal prism; MA25mm multi-coated eyepiece (1.25"); standard equatorial wedge with elevation scale, bubble level, and azimuth control; complete operating instructions.

8" LX50 Schmidt-Cassegrain	**$1395.**
10" LX50 Schmidt-Cassegrain	**1695.**
7" LX50 Maksutov-Cassegrain	**1795.**
Variable-Height Field Tripod	**295.**
7" Maksutov-Cassegrain Tube Ass'y	**1295.**

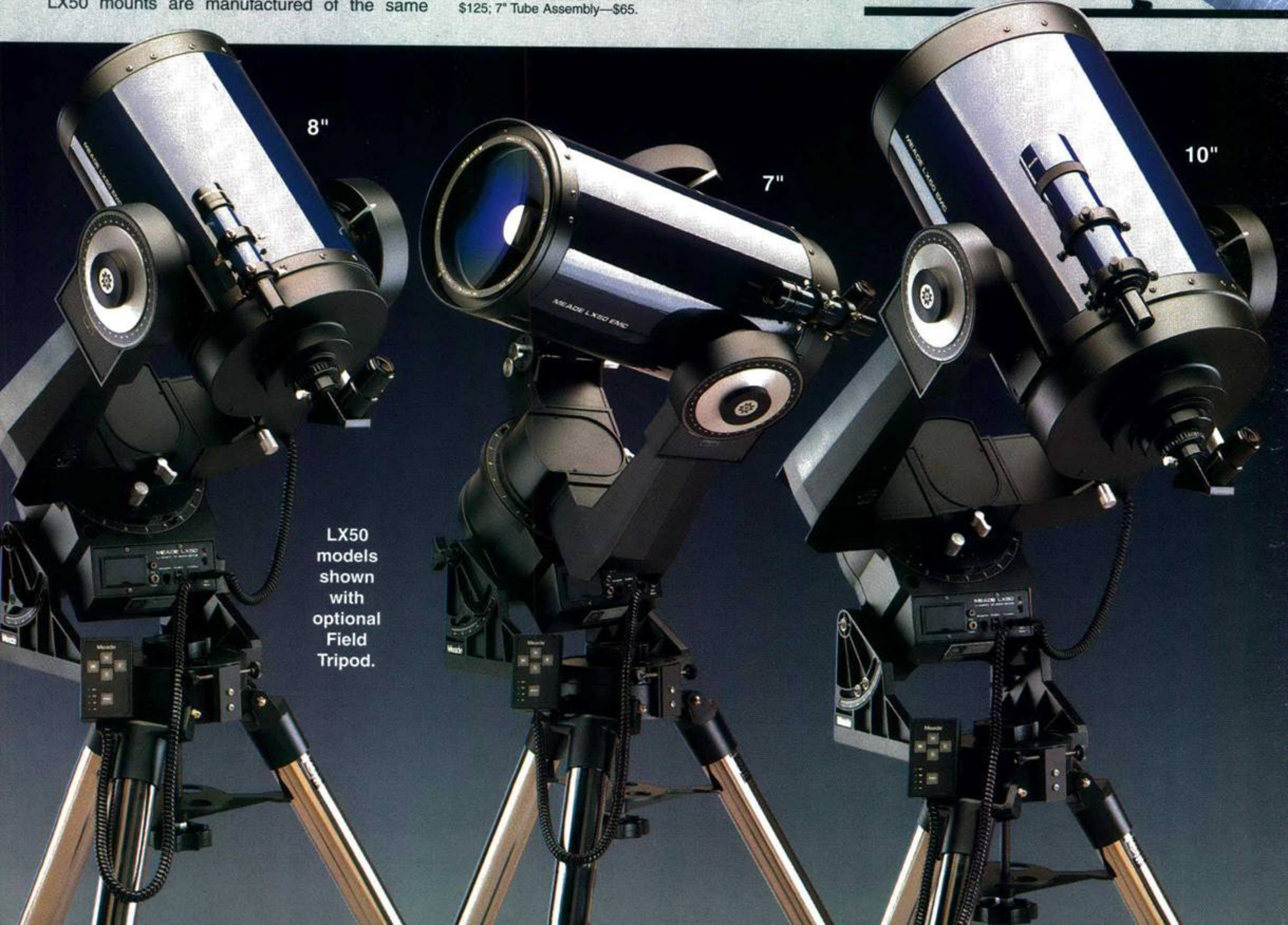
Packing and shipping in the 48 states: 8"—$105; 10"—$145; 7"—$125; 7" Tube Assembly—$65.

Meade Magellan™ II Computer-Corrector for LX50 Telescopes: Plug the Magellan II into the control panel of your LX50 and enjoy an incredible range of advanced capabilities. ■ Fast manual slewing to any object, either from input RA and Dec or from the 12,218-object database. ■ High-resolution 4096-pulse encoders (5.3 arc-minute precision), concealed in special LX50 encoder compartments. ■ Large 32-character, red-backlighted display. ■ Quick 2-star alignment. ■ Four-speed (2x, 8x, 16x, 32x sidereal) dual-axis drive corrector/microslewing system.

#2024: Magellan II for LX50's—Includes Magellan II hand controller *(right)*; encoders for both axes; all required mounting hardware. Installs to any LX50 in minutes. **$495.** + $15 packing and shipping in the 48 states.

MEADE
MAGELLAN II
COMPUTER · CORRECTOR
ENTER
MODE
FIND
N
W
E
S

only $495!



LX50 models shown with optional Field Tripod.

ADE

The largest-selling serious telescopes in the world.

LX200

In virtually every country in the world where serious telescopes are sold, more Meade LX200's are sold than all competing models *combined*. Consider these *standard-equipment* specifications:

- **Superb Optics:** LX200 diffraction-limited imaging capabilities are a legend in the industry; we regularly receive reports stating that optical performance approaches that of a fine *ED* apochromatic lens.
- **Automatic GO TO Capability:** Meade LX200's are *the only commercial telescopes ever manufactured* that automatically GO TO any input R.A. and Dec., or to any of 64,359 objects in the onboard database, *to a precision of one arc-minute or better.*

8" LX200 Schmidt-Cassegrain	**$2795.**
10" LX200 Schmidt-Cassegrain	**3195.**
12" LX200 Schmidt-Cassegrain	**4495.**
7" LX200 Maksutov-Cassegrain	**3295.**

Packing and shipping in the 48 states: 8"—$105; 10"—$145; 12"—$215; 7"—$125.

- **Meade LX200 High-Precision Pointing™** is so precise it permits the positioning of *every* selected object on *every* commercially-available CCD chip *every* time, automatically — *a feat that no other telescope priced under $40,000 can accomplish.*
- **Permanently-Programmable Smart Drive™** routinely achieves 5 arc. sec. periodic error, an observatory standard.
- **9-Speed Dual-Axis Electronics:** Electronics that cover every possible contingency of telescope positioning—from 2x photo-guide, to 32x image centering, to 8°/sec. slewing across the sky, as well as 6 other dual-axis drive speeds in between.
- **Field Operation:** No other telescopes of such incredible capabilities transport so readily for field operation. The optional #1812 Electronic DC Adapter (a compact 4 oz. unit) allows for field powering directly from an automobile cigarette lighter plug.

SPECIFICATIONS: 7", 8", 10", and 12" LX200's—Each complete telescope includes 8" or 10" (f/6.3 or f/10) or 12" f/10 Schmidt-Cassegrain or 7" f/15 Maksutov-Cassegrain optical tube assembly with EMC super multi-coatings; heavy-duty fork mount with 4" polar ball bearing, dual-axis 5.75" worm gears, and multi-function control panel; manual and electric slow-motion controls on both axes; keypad hand controller with digital readout display, permanently programmable Smart Drive, 9-speed drive controls on both axes (7-speed on 12"), High-Precision Pointing, and GO TO controller; 64,359-object onboard celestial software library; 25 ft. power cord and adapter for telescope operation from 115v.AC; 8 x 50mm viewfinder; 1.25" diagonal prism (7", 8", 10") or 2" diagonal mirror with 1.25" adapter (12"); Series 4000 Super Plössl 26mm eyepiece; standard field tripod (7", 8", 10") or giant field tripod (12"); operating instructions.

MEADE LX200 EMC
8"
7"
10"
12"
Meade

Write, call, or fax Meade Instruments for your free copy of the 94-page Meade 1997 General Catalog.

Prices shown are suggested U.S. mail-order retail prices.

ADVANCED PRODUCTS DIVISION

Meade Instruments Corporation

World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur

16542 Millikan Avenue, Irvine, Calif. 92606 ☐ (714) 756-2291

FAX: (714) 756-1450 ☐ *www.meade.com*

© 1997

July 1997 • Vol. 25, No. 7

Astronomy®

COVER PHOTO: Matthew H. Hall

FEATURES

38 **Inflating the Cosmos**
Cosmologists believe that the universe grew at a phenomenal rate in the instant just after the Big Bang. *Timothy Ferris.*

44 **Ka-Boom! How Stars Explode**
For decades astronomers tried to decipher exactly how stars explode. Now recent models suggest neutrinos provide the missing kick to nature's most violent events. *Robert Naeye.*

50 **Observer of the Gas Giants**
Planetary scientist Heidi Hammel revels in the surprisingly dynamic atmospheres of the outer planets. *Ruth Flanagan.*

56 **Something Instead of Nothing**
How did the universe arise out of the nothingness that preceded the Big Bang? *James Trefil.*

58 **Before Galaxies Were Galaxies**
By searching deep into the cosmos, astronomers may soon understand how galaxies formed. *William Keel.*

78 **Dusty Infant Stars: A Fine Sight**
Nearby open star clusters, such as the Pleiades, Hyades, and much of the Big Dipper, offer a visual treat even when seen with little or no optical aid. *Edmund A. Fortier.*

82 **Celestron's Big Bad Cat**
This 9¼-inch Schmidt-Cassegrain telescope provides a large aperture in a portable package. *John Shibley.*

86 **Ask Astro**
A leading astronomer answers your questions. *James B. Kaler.*

96 **Observing Perek-Kohoutek Planetaries**
Although they aren't the brightest objects in the sky, these softly glowing planetary nebulae make fine targets for big telescopes. *Tom Johnston.*

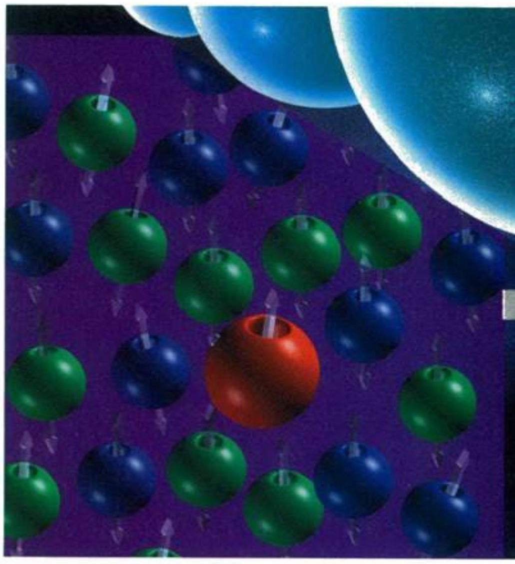
100 **Stargazing at Kitt Peak**
America's national observatory opens its doors to amateurs wanting to observe from this premier site. *Tom Polakis.*

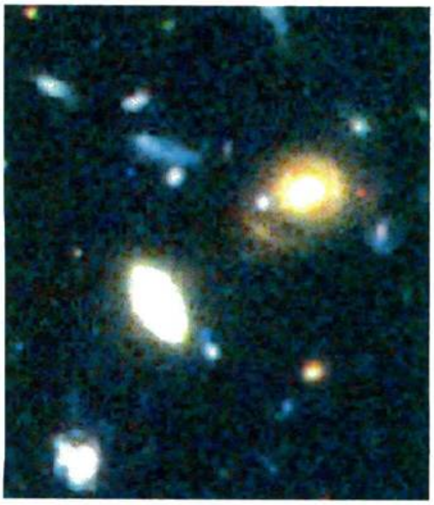
50 Observer of the Gas Giants

HST Comet Team and NASA

78 Dusty Infant Stars: A Fine Sight

Dewey Vanderhoff





58 Before Galaxies Were Galaxies

Rogier Windhorst and Sam Pascarelle (Arizona State Univ.) and NASA

82 Celestron's Big Bad Cat

Astronomy: Jim Forbes

DEPARTMENTS

6 Behind the Scenes
- About Our Facelift

16 Talking Back

22 AstroNews
- Hubble: A Weather Satellite for Mars
- An Ocean on Jupiter's Moon Europa?
- Smoking Gun for a Gamma-Ray Burst?
- The First Intergalactic Stars
- SOHO Views the Sun
- A Global View of Io
- Dusty Disk Found around Binary Star
- Hubble Solves Procyon Mystery
- Galileo to Keep Flying
- Closeup of Supernova Remnant
- High-Resolution Optical Images
- Quasars Surrounded by Normal Galaxies

66 Sky Almanac
- Uranus and Neptune shine at their brightest this month, which also sees several mutual events among Jupiter's moons. *Martin Ratcliffe and Alister Ling.*

108 Star Stuff
- The Whole Shebang: A State-of-the-Universe(s) Report
- Time Travel
- Space Travel
- The Earth Centered Universe, Version 3.0
- PlanetWatch Pro
- Modularized Dobsonians

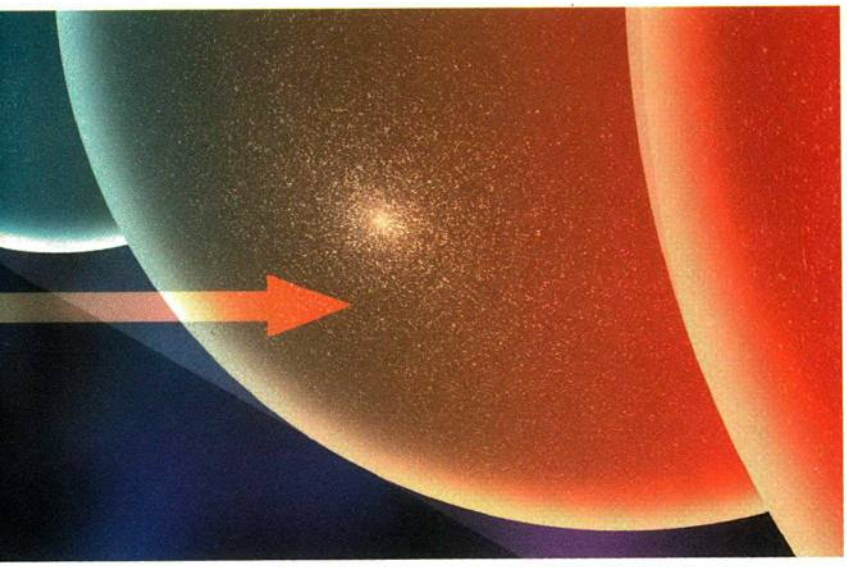
118 Looking Ahead

118 Resources and Photofacts

122 Advertiser Index

123 Hot Shots
- Hale-Bopp's Special Delivery

130 Ultimate Exposure



38 Timothy Ferris on an Inflating Universe George Krauter

100 Holiday at Kitt Peak

Tom Polakis

56 Something Instead of Nothing Stuart Briers

BEHIND THE SCENES

BY BONNIE GORDON

Our New Face

The grand comet Hale-Bopp has brought thousands of new astronomers out into the night skies, and we at *Astronomy* have been busy helping some of them along. At a Comet Party we threw with Chicago's Adler Planetarium last March, I spoke to dozens of people who were looking through a telescope for the first time. Other *Astronomy* editors encountered this too, and during the same weekend at Kitt Peak, where the National Observatory gave another party, assistant editor Patti Kurtz found that about half the folks she met had never used a scope before.

We're launching another kind of party with this issue. It's here in our pages. We're celebrating a new look and a new style, one we hope will satisfy the most discriminating sky watchers — and many newcomers to the hobby as well. We've opened up our design, hoping to give better presentation to our treasury of astronomical photos and paintings, and we've aimed for a more consistent look, so that you'll always know where you are when you're with us.

Dean Ketelsen

***Astronomy* assistant editor Patti Kurtz celebrates comet Hale-Bopp with discoverers Thomas Bopp, left, and Alan Hale at Kitt Peak National Observatory's March 22 comet party.**

With this issue too, we're offering some new kinds of stories. A first astronomy-related travel piece begins on page 100. It tells of one amateur's stay overnight on Kitt Peak as part of a new visitor's program. In the months ahead, we'll take you to the best planetariums, the best observatories, the best archeoastronomy sites. We'll take you on improbable astronomy tours of big cities, to settings famed for their good seeing, and to regions where your holiday could include a star party.

On page 86, find our first AskAstro, which depends on your questions for its survival. July's inaugural column brings answers from the accomplished astronomer James B. Kaler, but watch for it in every issue, and keep your questions coming. You'll also find a profile of astronomer Heidi Hammel, who revolutionized our understanding of the outer planets, on page 50. It's the first of many stories that will hint at the lives of scientists as it tells the story of their discoveries.

We want to know how you like what we've accomplished, so take a moment and write or e-mail. We still have plenty of room for growth and more than enough humility to bend to criticism. And if you have ideas we've missed for a more exciting *Astronomy*, share them with us.

Bonnie Bilyeu Gordon

Astronomy®

EDITORIAL STAFF

EDITOR
Bonnie Bilyeu Gordon

MANAGING EDITOR
David J. Eicher

ASSOCIATE EDITOR
Robert Naeye

ASSOCIATE EDITOR
John Shibley

ASSOCIATE EDITOR
Richard Talcott

ASSISTANT EDITOR
Patricia Kurtz

COPY EDITOR
Jeanette Brown

EDITORIAL ASSISTANT
Terry Williams Conley

EDITORIAL SECRETARY
Julie Sherwin

ART STAFF

ART DIRECTOR
Carole Kramer

GRAPHIC DESIGNER
Katherine Kolstedt

EDITORIAL ADVISORY BOARD

Buzz Aldrin, Timothy Ferris, Paul Hodge, John S. Gallagher III, Anne L. Kinney, Edward Kolb, Alan Lightman, Stephen P. Maran, James Trefil

PUBLISHER

Russell G. Larson

The Audit Bureau

ASTRONOMY (ISSN 0091-6358, USPS 531-350) is published monthly by Kalmbach Publishing Co., 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187. Editorial phone: (414) 796-8776; advertising: (800) 558-1544; customer service: (800) 446-5489; subscriptions: (800) 533-6644, 7 days a week, 24 hours a day; fax (414) 796-0126.
Copyright © 1997 Kalmbach Publishing Co., all rights reserved. Material in this publication may not be reproduced in any form without permission.
Periodicals postage paid at Waukesha, WI, and additional offices. Printed in the U.S.A. Allow 6 to 8 weeks for new subscriptions and address changes. Subscription price: 1 year $34.95, Canadian and foreign: 1 year $45, payable in U.S. funds (Canadian price includes GST). BN 12271 3209 RT. Canadian International Publications Mail Products Agreement 545-775. Not responsible for unsolicited materials. POSTMASTER: Send address changes to *ASTRONOMY*, 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187-1612.

MEADE LX10 EMC
Meade
MEADE
N
W
E
S

MEADE 8" LX10

All the optical performance of Meade 8" LX50 and LX200 Schmidt Cassegrains...for only *$995!*

For the serious amateur astronomer on a more limited budget, or for the more casual observer who nonetheless demands the very finest in optical performance, the Meade 8" LX10 satisfies every requirement. *No other similarly-priced 8" Schmidt-Cassegrain offers such a range of standard features* — or such a range of important options for special applications. *Standard-equipment includes:*

Super Multi-Coated Optical System: The LX10 includes the *exact same* 8" Schmidt-Cassegrain optical tube assembly as more expensive Meade 8" LX50 and LX200 models. Super multi-coatings (not available even as an *option* on competing 8" telescopes) are included with every LX10 optical system, for the highest levels of light transmission and image contrast.

Equatorial Fork Mounting: The relatively light weight, but very stable, LX10 fork mounting provides all of the rigidity required for sensitive high-power applications of the telescope, or for photographic or CCD imaging. Ball bearings on the polar axis complement the precise action of the internal worm gear system.

Cordless, DC-Powered Electronic Motor Drive: A drive system that includes an electronically-regulated DC servo motor for automatic *sidereal-rate* tracking. The drive is powered by four AA-size batteries that fit conveniently through the telescope's control panel; battery life is in excess of 50 hours.

Worm-Gear System: The LX10's 5.75"-diameter worm gear produces extremely smooth, regular motion in R.A., with low periodic error — a periodic error that permits such advanced capabilities as long-exposure astrophotography or CCD imaging.

Hand Controller: Essential for micro-guiding the telescope during long-exposure astrophotography, the LX10's pushbutton hand controller enables precise corrections in R.A. at 2x speed. With the optional electric Declination motor added to the telescope, the hand controller is functional at 2x speeds on both telescope axes. Both the standard-equipment hand controller and the optional electric Declination motor plug into the telescope's control panel.

Add the optional LX10 Declination Motor for dual-axis corrections at 2x.

Meade 8" LX10
Schmidt-Cassegrain Telescope, shown with standard-equipment equatorial wedge and hand controller and with optional LX10 Field Tripod.

SPECIFICATIONS: 8" Model LX10 — Includes 8" Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings (D = 203mm; F = 2000mm, f/10); fork mount with setting circles, manual slow-motion controls, and locks on both axes; 5.75" LX worm gear reduction system; sidereal-rate electronically-regulated DC servo motor drive; 4-pushbutton hand controller for 2x speed corrections in R.A.; battery compartment accepting four (user-supplied) AA-size batteries (telescope may also be powered from an auto cigarette lighter plug, using optional 25 ft. cord); 6 x 30mm viewfinder; eyepiece-holder and diagonal prism (1.25"); MA25mm multi-coated eyepiece; standard equatorial wedge with elevation scale, fine elevation control, and 360° azimuth orientation capability; complete operating instructions.
$995. (+ $65 packing & shipping in the 48 states)

LX10 Field Tripod	**195.**
LX10 Electric Declination Motor System	**85.**
#2014 Magellan I Telescope Computer System for LX10, with 12,218-object database	**375.**

The 94-page Meade 1997 General Catalog is available free of charge from Meade Instruments or from authorized Meade dealers. Prices shown are suggested U.S. mail-order prices.

© 1997

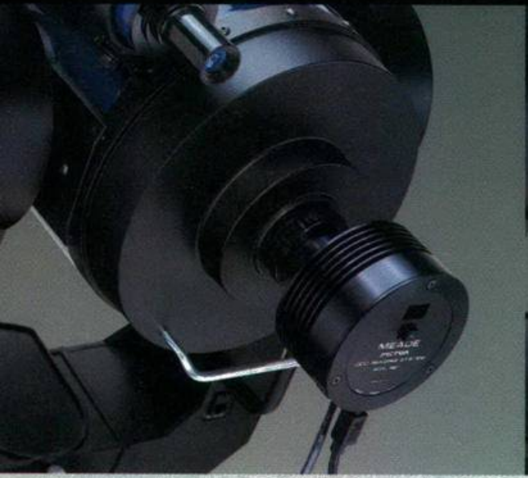
ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur
16542 Millikan Avenue, Irvine, Calif. 92606 ☐ (714) 756-2291
FAX: (714) 756-1450 ☐ *www.meade.com*

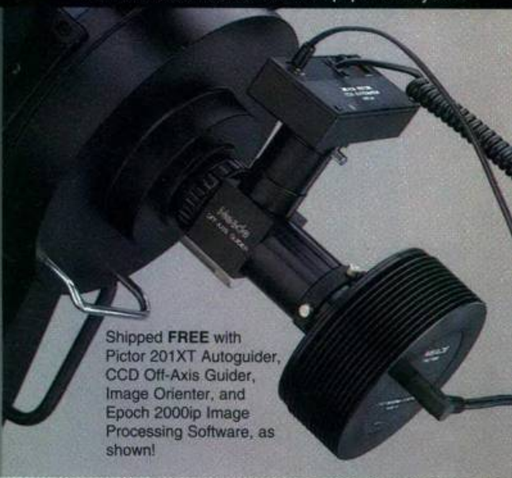
Meade Pictor 208XT
AUTOGUIDER/IMAGER
complete ***$495***

Meade Pictor 216XT
AUTOGUIDER/IMAGER
complete ***$695***

Meade Pictor 416XT
AUTOGUIDER/IMAGER
complete ***$1695***

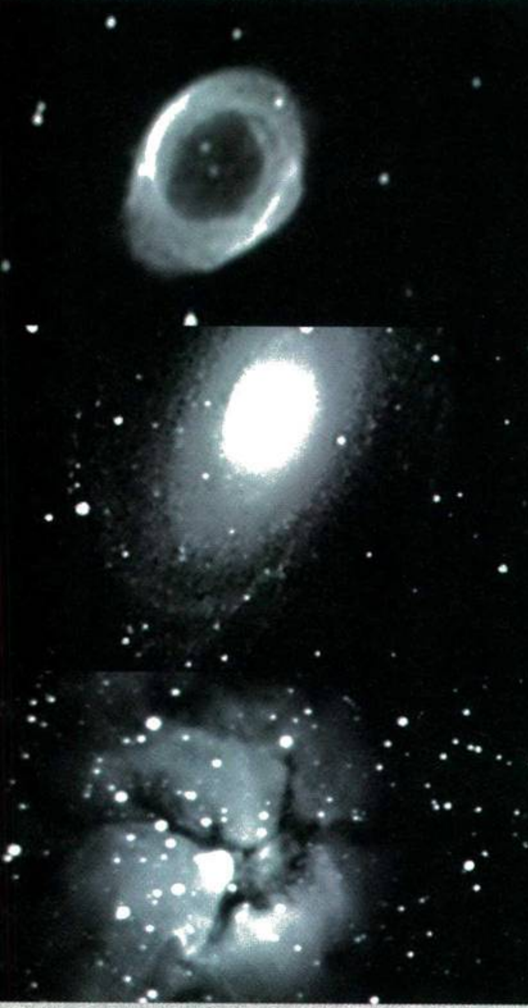
includes $800 Meade CCD Equipment System



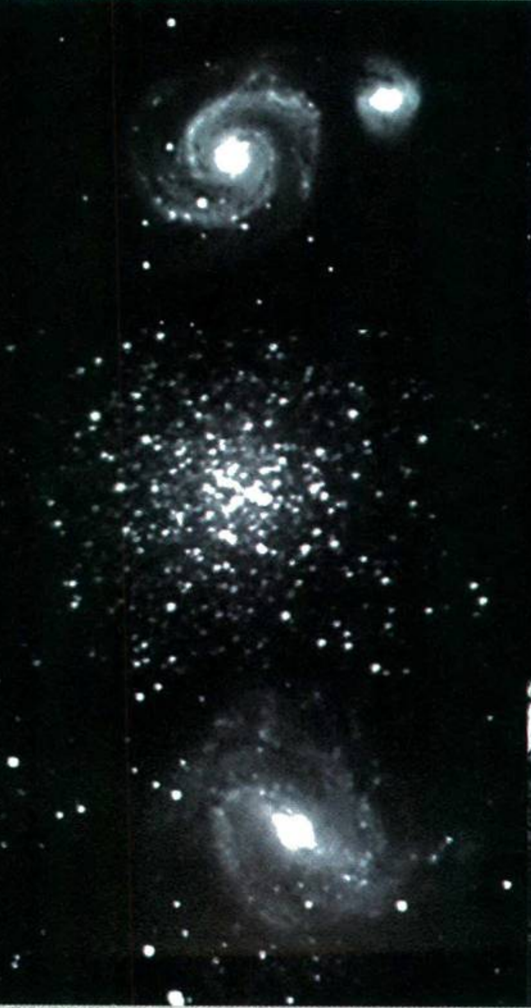


Shipped **FREE** with Pictor 201XT Autoguider, CCD Off-Axis Guider, Image Orienter, and Epoch 2000ip Image Processing Software, as shown!

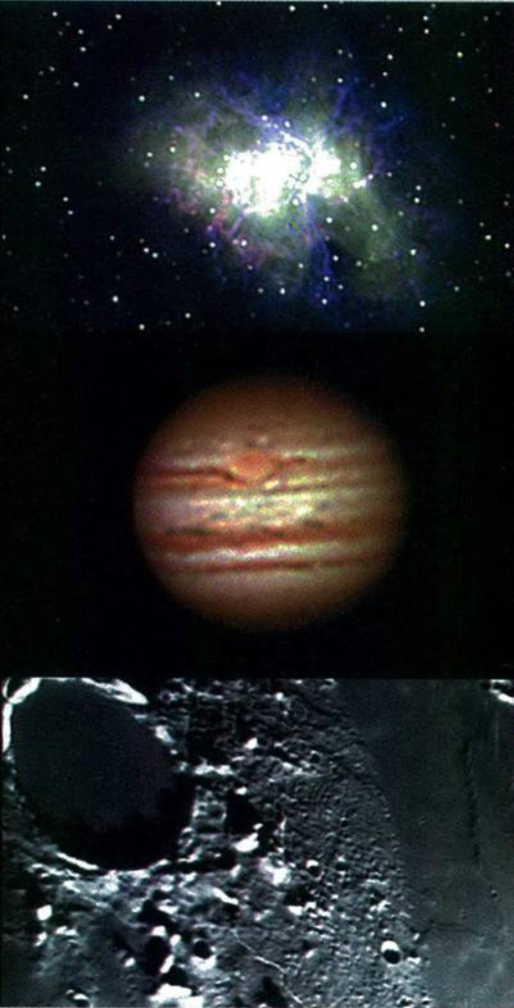
Revolutionary Meade Pictor CCD's are now the world's largest-selling autoguiders and imagers for the amateur astronomer. No other electronic imaging systems offer such an incredible range of capabilities at such amazing price levels. At only **$495** the **Pictor 208XT** produces on the PC display fine, high-resolution 8-bit images *in seconds* of the Moon and planets, or, in 2 or 3 minutes, of thousands of deep-space objects. At **$695** the **Pictor 216XT** enables advanced 16-bit imaging and is *by far* the finest autoguider/imager ever made available at under-$1000. At **$1695** the **Pictor 416XT** permits professional-level imaging capability for the amateur astronomer: an electronic camera capable of producing with amateur telescopes images of the Moon, planets, and deep-space that match or exceed the photographic images obtained with many observatory telescopes. All models are available for immediate shipment. ***For complete information on Meade CCD imaging systems write, call, or fax for your free copy of the 94-page Meade 1997 General Catalog.***



Pictor 208XT images *(top to bottom):* Ring Nebula (M57), 25" reflector, Jack Newton; Galaxy (M81) in Ursa Major, 12" LX200, Scott Roberts; Trifid Nebula (M20), 8" LX200, John Hoot.



Pictor 216XT images: Whirlpool Galaxy (M51), 12" LX200, John Hoot; Globular Cluster (M13), 25" reflector, Jack Newton; Galaxy (M83) in Hydra, 12" LX200, Scott Roberts.



Pictor 416XT images: Crab Nebula (M1), 25" reflector, Jack Newton; Jupiter, 10" LX200 with Stellar Products AO-2 seeing adapter, Dr. Donald Bruns; Moon (crater Plato), 16" f/6 reflector, Dr. Donald Parker.

© 1997

MEADE ETX

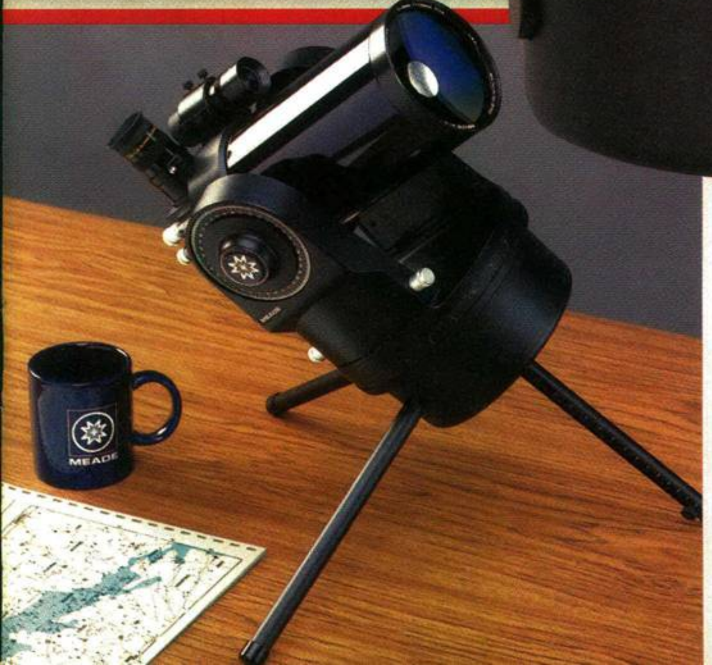
90mm Maksutov-Cassegrain

Meade ETX Astro Telescope. Shown with optional #64 Photo Adapter.

SPECIFICATIONS: ETX Astro Telescope— Includes Maksutov-Cassegrain optical tube assembly (D = 90mm, F = 1250mm, f/13.8) with EMC super multi-coatings; internal flip-mirror system for either straight-through or 90° observing position; equatorial fork mount with slow-motion controls, locks, and setting circles in R.A. and Dec; table tripod with elevation scale on center tripod leg; motor drive system with internal battery compartment accepting three (user-supplied) AA-size batteries; 8 x 21mm achromatic erect-image viewfinder; Series 4000 Super Plössl 26mm eyepiece (1.25"); operating instructions. *Net weight 9 lbs.* **$595***
(+ $20 packing and shipping in the 48 states)
*Suggested U.S. mail-order retail price.

Now you can have diffraction-limited imaging and ultraportability ...at only *$595*, *complete!*

The revolutionary Meade ETX goes anywhere with you at a moment's notice and presents the finest optical images ever made available in an ultraportable telescope.



Optical System: Manufactured at the Meade Irvine, California facility, ETX diffraction-limited optics produce images so high in contrast, brightness, and resolution that the ETX consistently outperforms telescopes of much larger apertures. **Equatorial Fork Mount:** Precise polar alignment in *seconds*, just by extending the center tripod leg to read your latitude on the inscribed scale. **Cordless Motor Drive:** The internal drive system operates from 3 AA-size batteries that power the motor drive for more than 50 hours. A North-South switch permits operation anywhere in the world. **Flip-Mirror System:** Flip the internal optical flat mirror "up" for 90° observing; flip the mirror "down" for terrestrial observing with the optional #932 45° Erecting Prism or for photography with the optional #64 Photo Adapter. **Standard accessories** include a Series 4000 Super Plössl 26mm eyepiece and 8 x 21mm erect-image viewfinder.

ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur
16542 Millikan Avenue, Irvine, Calif. 92606 □ (714) 756-2291
FAX: (714) 756-1450 □ *www.meade.com*

© 1997

MEADE STARFINDER DOBSONIANS

No other competing Dobsonians include this listing of *standard-equipment* features:

Primary and Secondary Mirrors of Low-Expansion Pyrex® Glass: Unlike the plate glass optics of other Dobsonians that can become thermally unstable, all Meade Dobsonian optics are made of Grade-A fine-annealed Pyrex glass — the exact same professional-quality optics used on Meade Starfinder Equatorials.

Rigid, Durable, Beautiful Dobsonian Mountings, manufactured of cabinet-quality materials, provide extremely smooth motions of the telescope in both altitude and azimuth. Both telescope axes ride on zero-backlash Teflon/Nylon bearings, facilitating the quick location and easy tracking of celestial objects.

Full-Size 1.25" Rack-and-Pinion Focuser: For smooth, precise focusing of the image without wobble or backlash. Focus travel is 2.6"; accepts 1.25" eyepieces.

4-Vane Steel Secondary Mirror System: Permits locked-in support and precise centration and alignment of the secondary mirror.

Multi-Coated MA25mm Eyepiece (1.25"): The Meade Modified Achromatic 25mm eyepiece yields sharp, high-resolution imaging to the field edge.

5 x 24mm Viewfinder: Included with all Starfinder Dobsonian models for quick object-location in the main telescope. With crosshair eyepiece and 2-ring bracket.

Optical Tubes: Starfinder Dobsonians include the same strong, spiral-wound Sonotube™ optical tubes used on Starfinder Equatorials *(right),* tubes with excellent insulating characteristics that reduce internal thermal currents to an absolute minimum.

Performance! *Meade Starfinder Dobsonians and Equatorials are the largest-selling Newtonian reflectors of their apertures in the world.* Every Starfinder model opens up the skies to an extremely wide range of serious visual observing; all 110 Messier objects, thousands of NGC objects — nebulae, galaxies, star clusters, in all their variations of form, color, and extent, as well as the Moon and planets in stunning high-resolution detail. Starfinder Dobsonians are telescopes for visual observing; motor-driven Starfinder Equatorials may be used, in addition, for lunar and planetary photography, and even for limited deep-space photography.

Packing & UPS Shipping Charges to any address in the 48 states: 6"—$39; 8"—$49; 10"—$69; 12.5"—$79; 16"—$45 packing, shipped truck freight collect.

Dobsonian Deluxe Accessory Package only $49.95!

Outfit your Meade Dobsonian with all of the most popular accessories for advanced observing. At the time you order any Dobsonian model, specify the following Deluxe Accessory Package for your telescope, in place of the standard-equipment focuser, viewfinder, and eyepiece, ***for a total of only $49.95 additional:***

- **1 - Meade #77 2" Giant Rack-and-Pinion Focuser,** with machined aluminum eyepiece-holders for both 2" and 1.25" eyepieces; includes drawtube lock and 2.6" focuser travel. *(reg. $59.95)*
- **1 - Meade #637 6 x 30mm Achromatic Viewfinder,** with wide 7° field; 2-ring metal bracket. *(reg. $49.95)*
- **3 - Meade MA9mm, 12mm, and 25mm** multi-coated eyepieces, 1.25" barrel — eyepieces for the full range of lunar, planetary, and deep-space observing. *(reg. $37.95 each)*

Purchased separately, the Deluxe Accessory Package sells for $223.75!

Meade Magellan I Telescope Computer System

Attach the optional Magellan I Telescope Computer System to your Starfinder Dobsonian and finding any of 12,218 celestial objects, or *any* object of known R.A. and Dec., is almost as easy as pointing the telescope! Magellan I's database includes the following objects:

7,840	NGC objects; the complete NGC catalog
4,093	IC objects from the Index Catalog
125	user-defined objects
110	Messier objects; the complete catalog
42	alignment stars for the Magellan system
8	major planets, from Mercury to Pluto
12,218	objects, total

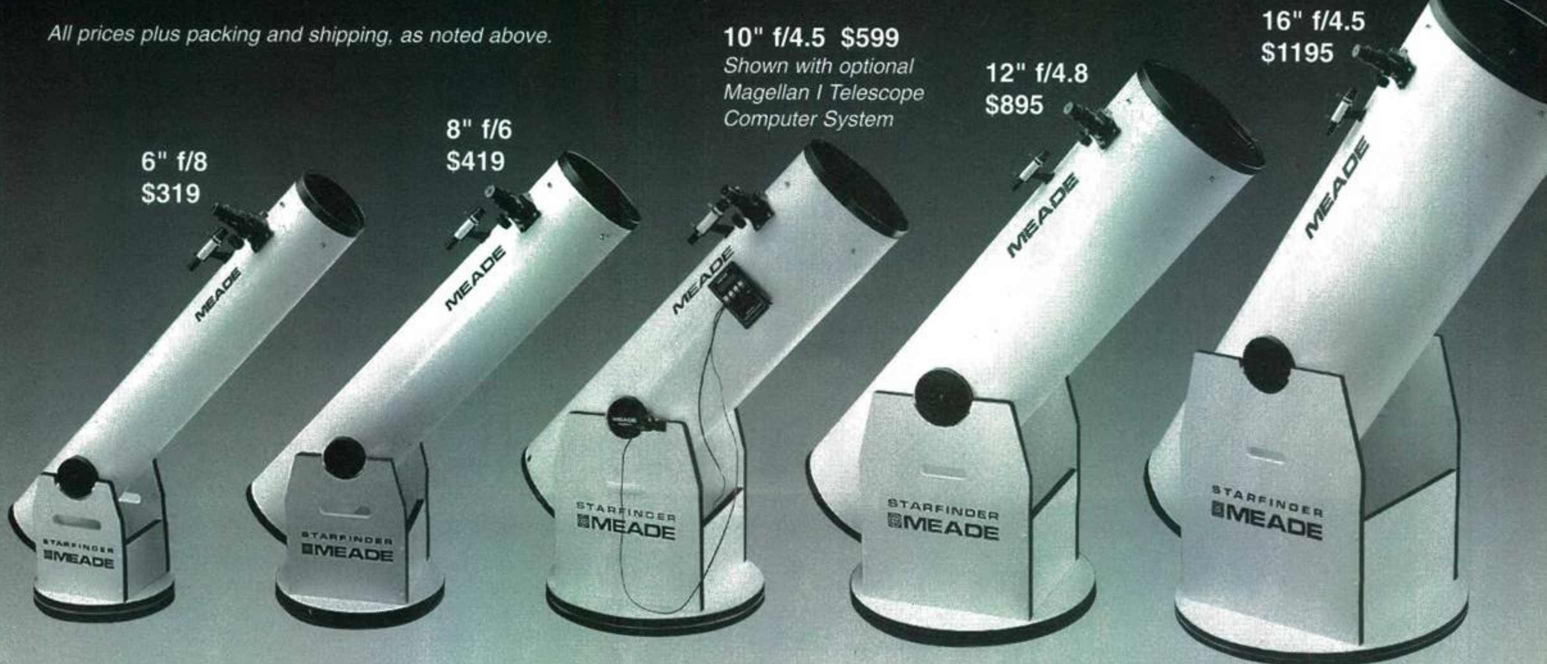
MEADE
ENTER
MODE
PREV
NEXT
ON
MAGELLAN I
TELESCOPE COMPUTER SYSTEM

Magellan I is supplied *complete* with control/display unit (4" x 5" x 1.25"); premium-grade, high-resolution encoders for each telescope axis (encoder precision is 5.3 arc minutes); RS-232 serial interface; bracket for placement of the controller on the telescope tube; and attachment hardware. Just add the user-supplied 9v. transistor radio battery, and Magellan I is ready to use. First-time installation is quick and simple.

#2010: for Meade Starfinder Dobsonian
6", 8", 10", 12.5", or 16" . . . . $295.
Packing & shipping in the 48 states—$15.

STARFINDER DOBSONIAN TELESCOPES ***Shown with standard-equipment 5 x 24mm viewfinder and 1.25" rack-and-pinion focuser.***

All prices plus packing and shipping, as noted above.



6" f/8
$319

8" f/6
$419

10" f/4.5 $599
Shown with optional Magellan I Telescope Computer System

12" f/4.8
$895

16" f/4.5
$1195

MEADE STARFINDER EQUATORIALS

DC-powered drive systems for fully automatic tracking, and a wide range of standard-equipment features:

Professional-Grade Optical System: Includes hand-figured, parabolic primary mirror and elliptical flat secondary, both of Grade-A Pyrex glass. Optics are multi-coated and meet the theoretical limits of resolution.

Precision Equatorial Mount: Manufactured of machined aluminum to tolerances of .001" or better, with 4"-dia. pier and die-cast tripod legs for rock-solid support of the optical tube. Moves effortlessly from object to object on precision bearing surfaces. Polar and Dec. shafts are 1" solid steel. Setting circles on both axes.

Battery-Powered Cordless Drive System! Provides fully automatic tracking of celestial objects. Operates for more than 50 hours from 6 (user-supplied) AA-size batteries. Control panel also permits powering the telescope from 12v. auto cigarette lighter plug, using optional 25 ft. cord.

2" Giant Focuser: Meade #77 2" giant rack-and-pinion focuser is included as standard equipment, with eyepiece-holders for both 2" and 1.25" eyepieces.

Accessories and Components: #637 6 x 30mm viewfinder with wide 7° field; multi-coated MA25mm eyepiece (1.25"); strong, durable, spiral-wound optical tube with attractive white finish.

Starfinder Equatorial 16: Includes equatorial mounting with 1.5" steel shafts, Sealmaster ball bearings, 6" dia. pier, and 6 x AA-size battery-powered worm gear drive; 8 x 50mm viewfinder; #77 2" giant focuser.

Packing & UPS Shipping Charges to any address in the 48 states: 6"—$65; 8"—$75; 10"—$90; 16"—$55 packing, shipped truck freight collect.

Meade Magellan Telescope Computer Systems

MEADE
ENTER
MODE
PREV
NEXT
ON
MAGELLAN I
TELESCOPE COMPUTER SYSTEM

Magellan I: Use the Magellan I computer to manually slew the telescope quickly to any of 12,218 database objects, or to any object of known R.A. and Dec. Specifications and object database are identical to Magellan I for Starfinder Dobsonians *(see facing page).*

#2011: for Meade (DC-powered) Starfinder Equatorial 6", 8", or 10" . . . . $295.
#2012: for Meade (DC-powered) Starfinder Equatorial 16" . . . . 295.

MEADE
MAGELLAN II
COMPUTER · CORRECTOR
ENTER
MODE
FIND
N
W
E
S

Magellan II Computer-Corrector: Plug the Magellan II into the control panel of your Meade Starfinder Equatorial and you have all the capabilities of the Magellan I, above, including 12,218-object database, *plus* a 4-speed (2x, 8x, 16x, 32x), dual-axis, drive corrector/microslewing system.

#2018: for (DC-powered) Starfinder Equatorial 6", 8", 10" . . 495.
#2019: for (DC-powered) Starfinder Equatorial 16". . . . . 595.

Packing & shipping in the 48 states: Magellan I–$15, Magellan II–$20.

Special Eyepiece Offer! At the time you order any Meade Starfinder Equatorial telescope, you can buy 2 additional multi-coated eyepieces, MA9mm and 12mm, ***for a total of $29.95!*** *Purchased separately, the 2 eyepieces sell for $75.90.*

The fullest exposition of Meade astronomical telescopes, CCD imagers, and telescope accessories is contained in the 94-page Meade 1997 General Catalog.

Write, call, or fax Meade Instruments for your free copy!

To Order: Contact your authorized Meade Advanced Products Dealer. Prices shown are suggested U.S.A. mail-order retail prices.

AUTHORIZED U.S. MAIL-ORDER DEALERS

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

CALIFORNIA TELESCOPE COMPANY, Burbank, CA.
Orders & Information: 818-505-8424.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 510-447-9570.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; Illinois: 312-332-2000.

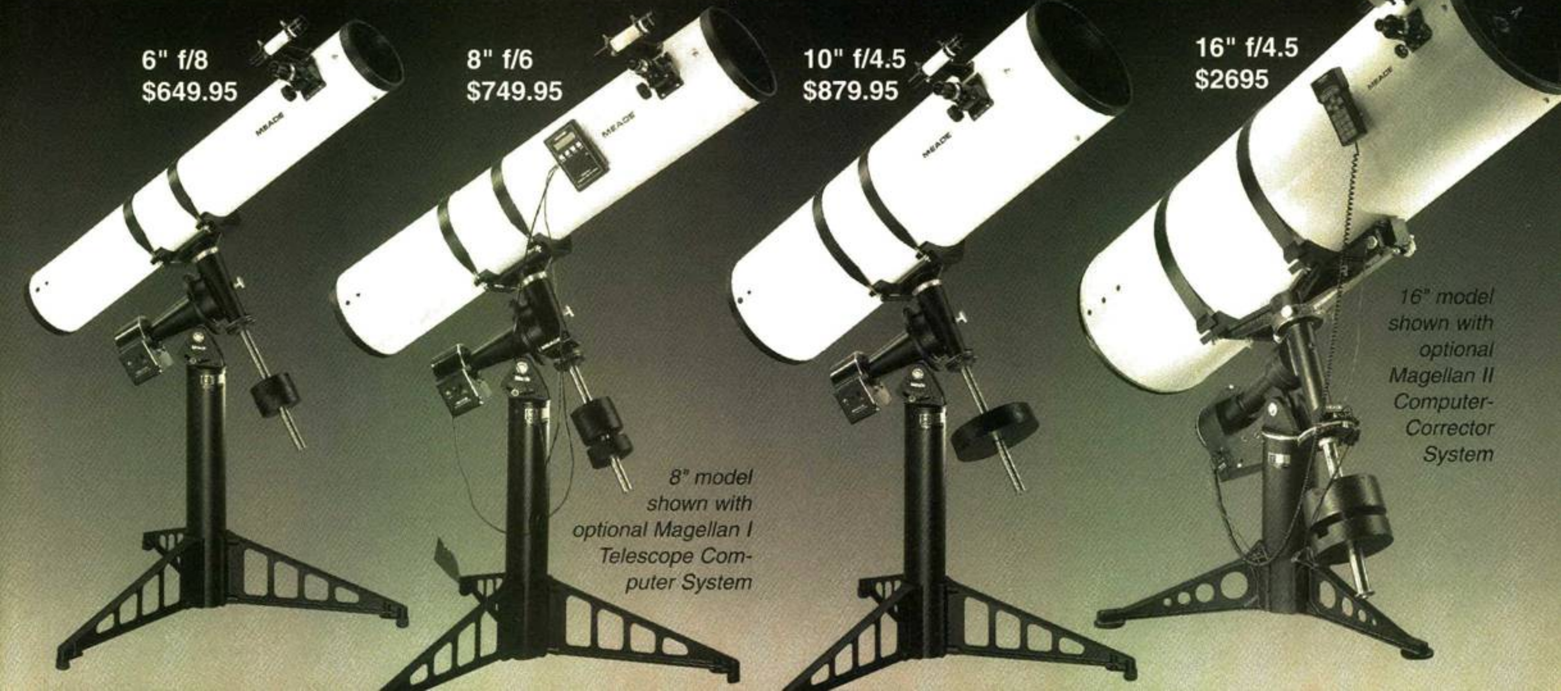
Canada:

EFSTONSCIENCE, Toronto, Ontario.
Orders & Information: 416-787-4581.

KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur
16542 Millikan Avenue, Irvine, Calif. 92606 ☐ (714) 756-2291
FAX: (714) 756-1450 ☐ *www.meade.com*
© 1997

STARFINDER EQUATORIAL TELESCOPES ***Shown with standard-equipment 6 x 30mm or 8 x 50mm viewfinder and 2" giant focuser.***



6" f/8
$649.95

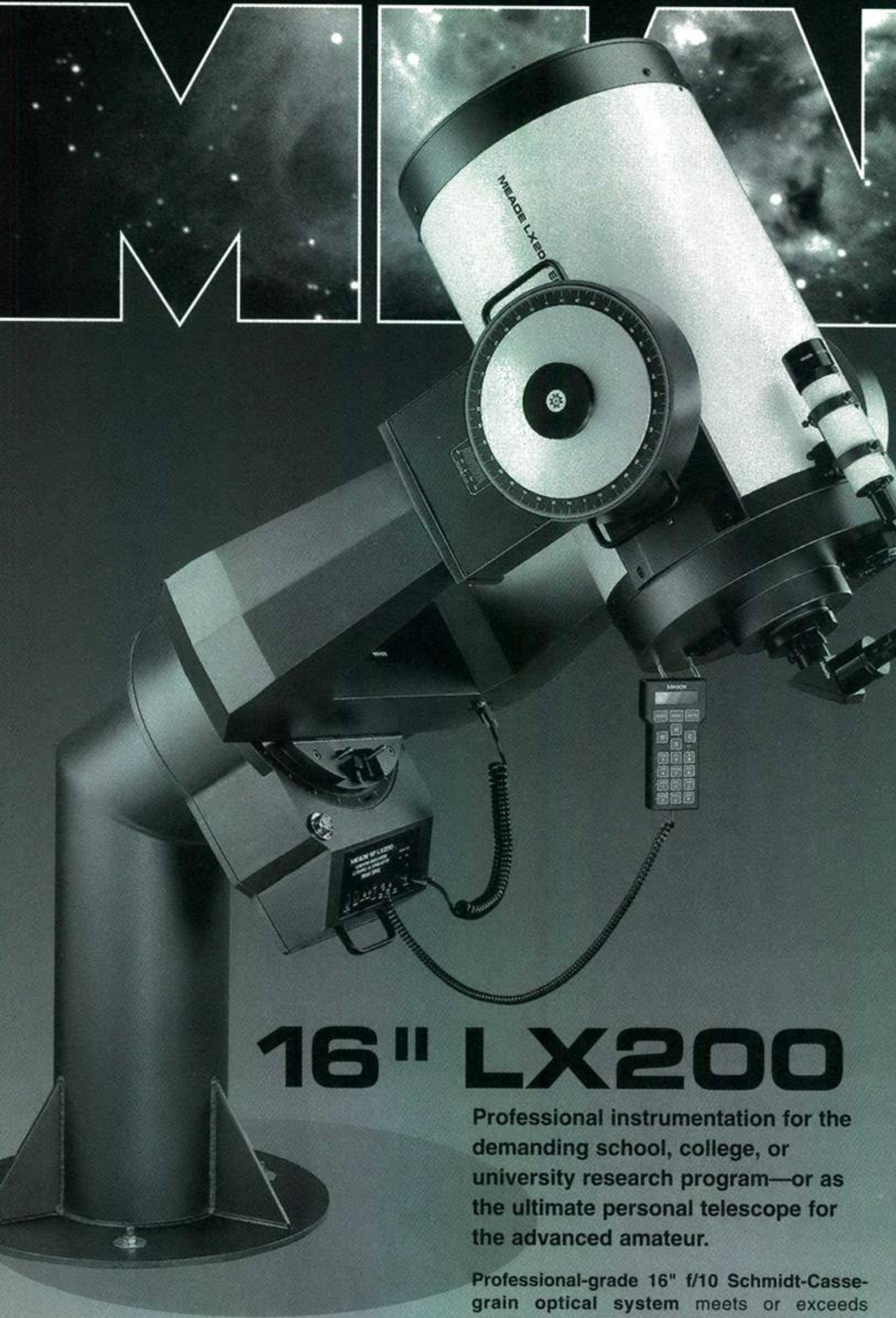
8" f/6
$749.95

10" f/4.5
$879.95

16" f/4.5
$2695

8" model shown with optional Magellan I Telescope Computer System

16" model shown with optional Magellan II Computer-Corrector System



16" LX200

Professional instrumentation for the demanding school, college, or university research program—or as the ultimate personal telescope for the advanced amateur.

Professional-grade 16" f/10 Schmidt-Cassegrain optical system meets or exceeds advanced requirements; includes BK7 correcting plate with EMC super multi-coatings for high UV transmission. ■ **Massive one-piece fork mount** permits substantial auxiliary equipment to be piggybacked with rock-solid stability. ■ **Large 11" worm gears** on both axes, with factory-programmed Smart Drive™; periodic error less than 5 arc seconds. ■ **Automatic GO TO capability** to any object in the onboard 64,359-object database or to any input R.A. and Dec. ■ **High-Precision Pointing™** to within one arc-minute in the GO TO mode. ■ **DC servo drive systems** with integrated encoders and planetary gearboxes; encoder resolution: 0.13 arc secs. ■ **Six pushbutton-controlled drive-speed rates,** from photo-guide to fast-slew on both axes, simultaneously. ■ **Microprocessor controlled sidereal-rate tracking** in AZ or EQ modes with quartz accuracy. ■ **Home-Pulse Acquisition** permitting remote alignment and operation through a modem link to the telescope's RS-232 interface. ■ **Control panel connectors** for optional systems including CCD autoguiders and imagers, electric focuser, and the Meade **#1222 Field De-rotater** for long-exposure astrophotography in the AZ mode. ■ Available with **supergiant transportable field tripod** (2-person field set-up in less than 10 minutes); **permanent altazimuth pier** (permitting the entire instrument to be housed in a 2-meter dome); or **permanent equatorial pier** (in cases where piggybacked astrocameras do not permit field de-rotation).

Meade 16" LX200 Schmidt-Cassegrain, with Supergiant Transportable Field Tripod.

Write, call, or fax Meade Instruments for your free copy of the 94-page Meade 1997 General Catalog, with complete information on more than 40 Meade telescope models.

ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur
16542 Millikan Avenue, Irvine, Calif. 92606 ☐ (714) 756-2291
FAX: (714) 756-1450 ☐ *www.meade.com*

© 1997

The Meade 16" LX200 is in continuous production at the Meade Irvine, Calif. factory. **Delivery time:** 4 to 12 weeks. **Price:** $14,950, complete with supergiant field tripod, plus $385 packing and shipping in the 48 states; prices slightly higher with permanent altazimuth or equatorial pier.

EYEPIECES AND ACCESSORIES

Series 4000™ Super Plössls
52° field; multi-coated

Meade 4-element Super Plössls, updated and redesigned to utilize the latest in optical glass-types, are the finest general-purpose eyepieces available. For observing hairline lunar and planetary detail, splitting close doubles, or for deep-space; guaranteed to deliver more contrast and image sharpness than any other brand. Rubber eyeguards fold down for eyeglass wearers–a feature not available on competing brands. Multi-coated. All focal lengths through 32mm are parfocal.

Super Plössls (SP; 4-elements; 1.25"; 52°):
6.4, 9.7, 12.4, 15, 20, 26mm each: **$79.95** (3.45)
32mm (52°); **40mm** (44°) each: **99.95** (3.79)
56mm (52°; 2") **199.95** (5.48)

Series 4000™ Ultra Wide Angle 84° field; multi-coated

The ultimate eyepieces; extreme image sharpness over an amazing 84° field. A perfect optical match with Schmidt-Cassegrains and fast Newtonians.

Ultra Wide Angle (UWA; 8-elements; 1.25"; 84°)– **4.7mm: $169.95** (3.94); **6.7mm: 199.95** (3.94); **8.8mm** (1.25"/2"): **239.95** (5.87); **14mm** (1.25"/2"): **299.95** (6.28)

Series 4000™ f/6.3 Focal Reducer/ Field Flattener

f/6.3 FOCAL REDUCER/FIELD

Manufactured to exclusive Meade optical designs; threads on to any Meade or Celestron Schmidt-Cassegrain rear cell and converts f/10 scopes to f/6.3 (or f/6.3 SCT's to f/4), while significantly flattening the field. Use with SCT visual or photo accessories. Actual visual field is increased by 56%, for fine wide-field views of star fields and nebulae. In astrophotography, reduces exposure times by about 50%, while producing an actual field diameter of 1.5" at the film plane. A tremendous aid with CCD imagers in reducing image size for locating and centering images on CCD chips. 4-element optics; multi-coated; 41mm clear aperture.

$129.95 (3.60)

2x Telenegative Barlow (1.25")

#122: Doubles eyepiece power with sharp, high-resolution, high-contrast imaging on telescopes of all types. 27mm dia. (26mm clear aperture). Excellent corrections for chromatic and spherical aberrations at all photo-visual wavelengths. Multi-coated. 1.25"

$47.95 (3.45)

2x Short-Focus Barlow (1.25")

#126: Only 2.5" long, the #126 works well with any telescope accepting 1.25" eyepieces, even those with limited focus range. Maintains the high image quality of the #122, above. Insert the #126 into star diagonal for 2x or insert star diagonal into #126 for 3x. 26mm clear aperture. Multi-coated.

$47.95 (3.45)

2x-3x Variable Barlow (1.25")

#127: Precision internal sliding lens assembly permits continuously variable power settings between 2x and 3x. Engraved scale indicates power in use. Yields bright, sharp, high-contrast images on telescopes of all types. Multi-coated; 1.25".

$59.95 (3.45)

2" Diagonal Mirror

#929: Permits use of wide-field 2" oculars. Threads on to rear cell of Meade and Celestron SCT's. Includes multi-coated precision optical flat made at the Meade factory; with 1.25" eyepiece adapter. **#930:** Same as #929 but with 2" barrel to fit into focusers with 2" eyepiece-holders.

#929 or **#930,** each: **$99.95** (5.87)

45° Erecting Prisms

Fully coated roof prisms to invert the astronomical image in Schmidt-Cassegrains or refractors during terrestrial observations, while presenting a convenient 45° observing angle. Specify **#927** (.965"), **#928** (1.25"), or **#931** (fits .965" focuser, accepts 1.25" eyepieces).

$42.95 (3.45)

World's Most Advanced Illuminated Reticle Eyepiece

Series 4000 Plössl 9mm, with rubber eyecup and micrometric X-Y positioning of the reticle within the field. Greatly facilitates locking on the guide star. Sharp high-power imaging, excellent eye relief. Wireless red LED illuminator with adjustable brightness control. Multi-coated optics. **Internal batteries included.** Bullseye reticle. 1.25".

$149.95 (3.45)

Series 4000 Plössl 9mm—Same as above but with 6 ft. cord and plug for Meade LX3, LX5, LX6, LX100, LX200, and APO power panels, in place of wireless illuminator.

$129.95 (3.45)

Series 4000 Photo-Visual Color Filters (1.25")–Premium filters, made of purest crown optical glass, dyed in the mass. For increased contrast and resolution on the Moon and planets. Thread into the barrels of virtually all 1.25" eyepieces sold today. Fully coated.

#8 Lt. Yellow; #11 Yellow Green; #12 Yellow; #21 Orange; #23A Lt. Red; #25A Red; #38A Dark Blue; #47 Violet; #56 Lt. Green; #58 Green; #80A Blue; #82A Lt. Blue each **$14.95** (2.29)

Set #1–4 filters: #12, #23A, #58, #80A **49.95** (2.98)
Set #2–4 filters: #11, #25A, #47, #82A **49.95** (2.98)
Set #3–4 filters: #8, #21, #38A, #56 **49.95** (2.98)

Series 4000 Moon Filter (#ND96): Reduces glare and irradiation during lunar observing. 13% uniform light transmission across the visual spectrum. Threads into 1.25" barrels. **$16.95** (2.29)

#905 Variable Polarizer (1.25")

For glare reduction in observing the Moon. Includes two Polarizer filters mounted in a machined cell and permits continuously variable light transmission from 5% to 25%, to compensate for varying lunar surface brightness according to the Moon's phase and the aperture of the telescope. Accepts 1.25" eyepieces. **$49.95** (4.27)

Modified Achromatic Eyepieces

Meade 3-element MA eyepieces yield sharp, well-corrected images on the Moon, planets, and deep-space at a reasonable price. Multi-coated; threaded for filters; 1.25" barrel diameter. Apparent field: 40°. **MA 9, 12, 25, 40mm.**

each: **$37.95** (3.45)

MA12mm Illuminated Reticle Eyepiece

Excellent 3-element optical system, long eye relief, fully coated, with double crossline reticle. Wireless red LED illuminator and variable brightness control. 1.25" **Batteries included.** **$99.95** (3.45)

As above but with 6 ft. cord and plug for Meade telescopes with power panels, in place of wireless illuminator. **$79.95** (3.45)

Camera Adapters

Professional-quality adapters for rigid coupling of telescope-to-camera. Use for either Eyepiece-Projection or Prime Focus. Precision-machined of aluminum and brass, threaded for filters. Use with T-mount, available separately.

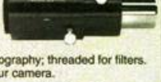
.965": $27.95, **1.25": $29.95** (2.98)

Variable Tele-Extender

For eyepiece-projection photography with any Meade or Celestron SCT. Threads on to eyepiece-holder. Sliding cell with lock permits wide range of projection magnifications with the same eyepiece. Use with T-mount for your camera.

$39.95 (2.98)

Variable-Projection Camera Adapter (1.25")



Machined sliding cell allows variable projection power in eyepiece-projection photography; permits precise selection of correct photo power in lunar and planetary photography; threaded for filters. Use with T-mount for your camera.

$39.95 (2.98)

T-Adapters for SCT's

Rigidly couples camera to telescope for prime focus photography with any Meade or Celestron Schmidt-Cassegrain. Use with T-Mount for your 35mm camera.

$26.95 (2.98)

Series 4000™ 2x Apochromatic Barlow Lens

#140: The most advanced Barlow lens available for commercial telescopes, the Meade #140 includes 3-element, multi-coated, air-spaced optics. Doubles the power of any eyepiece with which it is used and yields images absolutely unmatched in resolution, contrast and color correction. The #140 optically complements any telescope — refractor, reflector, or Schmidt-Cassegrain. Accepts 1.25" eyepieces. Mechanical components are of machined aluminum and brass. Lens diameter is 28mm; clear aperture 26mm.

$79.95 (4.27)

Series 4000™ Super Wide Angle 67° field; multi-coated

For exquisite wide-angle images at low-to-medium powers, with pinpoint edge-of-field resolution. Ideal for star fields, galaxies, and other deep-space phenomena. SWA 13.8mm, 18mm, and 24.5mm are superb complements to the #140 Barlow, above.

Super Wide Angle (SWA; 6-elements; 1.25"; 67°)–**13.8mm: $139.95** (3.94); **18mm: 149.95** (3.94); **24.5mm: 179.95** (4.68); **32mm** (2"): **239.95** (5.87); **40mm** (2"): **299.95** (6.28)

Series 3000™ Plössls 50° field; multi-coated

The very latest in eyepieces from Meade optical designers, new Meade Series 3000 Plössls yield the finest image corrections obtainable from the classical 4-element Plössl design. Available in a wide range of focal lengths from 5mm through 25mm. All five eyepieces are parfocal, so that, at most, only slight refocusing of the image is necessary from eyepiece to eyepiece. Unlike competing moderately-priced Plössls, Meade Series 3000's are **multi-coated** for maximum light transmission and image contrast. Chrome-plated brass barrels are threaded for standard filters. Manufactured exclusively for Meade Instruments by one of Japan's leading lensmakers, Series 3000 Plössls produce fine, high-resolution results on reflectors, refractors, and Schmidt-Cassegrains of any focal ratio.

Series 3000 Plössls (4-elements; 1.25"; 50°)
5, 6.7, 9.5, 16, 25mm each: **$49.95** (3.45)

#911B
#910B
#908B
#911N
#910N
#908N

Series 4000 Nebular Filters—Premium multi-layer interference filters, the finest obtainable. Use broadband ("B") filters to block most forms of light pollution; use narrowband ("N") filters in heavily light-polluted areas or for extremely high-contrast observing of faint nebulae.

#908B–Threads into 1.25" eyepieces, 26mm dia. **79.95** (3.45)
#910B–Threads into 2" eyepieces, 44mm dia. **119.95** (3.85)
#911B–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia. **99.95** (3.94)
#908N–Threads into 1.25" eyepieces, 26mm dia. **89.95** (3.45)
#910N–Threads into 2" eyepieces, 44mm dia. **129.95** (3.85)
#911N–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia. **119.95** (3.94)

Series 3000™ Plössl 40mm 44°

An excellent complement to the Series 3000 Plössls above, this all-new Plössl 40mm produces spectacular low-power, wide-field results with any telescope. Includes classical 4-element Plössl optics, **multi-coated.** Barrel dia. 1.25"; threaded for filters. Apparent field: 44°.

$79.95 (3.79)

HOW TO ORDER

■ Prices shown are suggested U.S.A. mail-order retail prices and do not include any applicable sales taxes.

■ Suggested shipping and handling charges to the 48 states by U.P.S. or U.S. Mail shown in ( ) next to each price.

■ Meade accessories may be ordered from any Meade Advanced Products Dealer. **The following national mail-order dealers carry all Meade accessories in-stock for immediate shipment:**

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

CALIFORNIA TELESCOPE CO., Burbank, CA.
Orders & Information: 818-505-8424.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 510-447-9570.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 312-332-2000.

Canada:

EFSTONSCIENCE, Toronto, Ontario.
Orders & Information: 416-787-4581.

KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

© 1997

MEADE

THE LARGEST-SELLING TELESCOPES IN THE WORLD

Meade Instruments is pleased to recommend the authorized Meade dealers on these pages for your telescope-buying requirements. Whether you're looking for a quality entry-level telescope at under-$200, a fully equipped professional instrument at over-$5000, or one of more than 2 dozen models in between, there's a Meade telescope that's right for your budget and applications.

NATIONAL

Meade Telescopes and Accessories
are available at
THE NATURE COMPANY
Over 100 stores nationwide.
Call **1-800-607-7888**

MULTIPLE STATES

DISCOVERY CHANNEL STORES
Orlando, Florida—Florida Mall
407-859-7001
Dallas, Texas—Dallas Galleria
214-701-8660
Atlanta, Georgia—Phipps Plaza
404-841-0081

ARIZONA

ASTRONOMY SHOPPE
Authorized Meade Dealer
Serving the Greater Phoenix Area
15836 N. Cave Creek Rd., Phoenix, AZ 85032
602-971-3170

ARIZONA

Quality Meade telescopes and accessories
Mr. Telescope
20 E. Camelback Rd.
Phoenix, AZ 85012
602-955-5521

CALIFORNIA

Studio City Camera
Full-line Meade. Optical expert on staff. Over 50 years' experience selling telescopes!
12174 Ventura Blvd., Studio City, CA 91604
818-762-4749

CALIFORNIA

WHAT IN THE WORLD
We will demo Meade products in our dark mountain skies!
28200 Hwy. 189, #E-210
Lake Arrowhead Village, CA 92352
909-337-5080

CALIFORNIA

"Your Meade Specialist"
Most items in stock
Oceanside Photo & Telescope
1024 Mission Ave., Oceanside, CA 92054
1-800-483-6287
E Mail: OPT@CTS.COM

CALIFORNIA

Claremont Camera & Video
If it's quality Meade telescopes you're looking for – We offer it all!
863 W. Foothill Blvd., Claremont, CA 91711
909-626-2219

CALIFORNIA

Huge Meade inventory at low prices
Woodland Hills Camera
Telescopes • Binoculars
5348 Topanga Canyon Blvd., Woodland Hills, CA 91364
818-347-2270 or toll-free
Buy, Sell **1-888-4-ASTRONOMY** ***Trade***

CALIFORNIA

Largest Meade Display in California!
Boot's Camera
5587 North Blackstone Ave.,
Fresno, CA 93710
209-432-0446

COLORADO

Mike's Camera, Inc.
We carry one of the largest supplies of quality telescopes and accessories.
2500 Pearl St., Boulder, CO 80302
303-443-1715

CONNECTICUT

WHOLESALE OPTICS
Product - Price - Professionalism - Performance - We Have It All! Orders 7 Days 9 am - 12 midnight
Showrooms/Business Office:
57 North St., Suite 401, Danbury, CT 06810
Phone: **203-746-3579** • Fax: **860-355-3132**

FLORIDA

Sarasota Camera Exchange & Video Center
Telescope specialists! We help you choose the right scope or accessory. Big stock of Meade!
1055 S. Tamiami Tr., Sarasota, FL 34236
941-366-7485

FLORIDA

Great National Camera Machine
Competitive Prices! Expert Service! Sales Nationwide! 30 Year Reputation.
1650 North Military Trail, Suite 104
West Palm Beach, FL 33409, 407-689-3166
Out of State 1-800-9-CAMERA

FLORIDA

PHIL'S CAMERA SERVICE
South Florida's Largest Selection of Quality Optical Instruments.
11517 S. Dixie Hwy., Miami, FL 33156
305-238-7842

FLORIDA

Jim's Photo Shack, Inc.
Authorized Meade dealer. We know telescopes—call for expert advice.
4100 E. Bay Dr., Clearwater, FL 34624
813-536-9661

FLORIDA

Complete line of fine Meade Products
Kenin Scientific & Optical Products
Big Display and We Do Mail Orders
1830 N.E. 163 St. • North Miami Beach
Phone: **305-940-7804** • Fax: **305-947-5943**

GEORGIA

Camera Bug Ltd.
Atlanta's Leading Telescope and Binocular Dealer. We Ship Practically Anywhere.
1799 Briarcliff Rd., Atlanta, GA 30306
404-873-4513 • Fax 873-3925

MASSACHUSETTS

F.C. Meichsner Co.

Decades of sales and service to New England's astronomers. Visit our accessible Boston showroom.

182 Lincoln St., Boston, MA 02111
1-800-321-VIEW

MASSACHUSETTS

Full-line dealer! We accept trade-ins! Meade telescopes on display for your inspection!

Harvard Camera

Town of Harvard: **508-456-8100**
Fitchburg: **508-345-2144**

MICHIGAN

RIDER'S HOBBY SHOPS

Serving Michigan Since 1972
Competitive Discount Prices
Call Pete at **616-349-2666** for expert advice and the store location nearest you.
HTTP://RIDERS.COM

MONTANA

NIGHT SKIES

Come and see the largest display of telescopes and accessories in Montana.

1550 Amsterdam Rd., Belgrade, MT 59714
Phone: **406-388-1205** e-mail: **nightsky**@alpinet.net

NEW JERSEY

N.J.'s Largest Display of Meade Telescopes.

Dover Photo Supply

25 E. Blackwell St.
Dover, NJ 07801
201-366-0994

NEW JERSEY

TUTHILL YOUR ASTRONOMICAL FRIEND

A full-line Meade dealer for 17 years!

11 Tanglewood Lane
Mountainside, NJ 07092
1-800-223-1063

NEW MEXICO

PhotoSupply, Inc.

Stocking New Mexico's largest selection of Meade telescopes.

DeVargas Shopping Ctr., Santa Fe, NM 87501
505-982-2585

NEW YORK

Berger Bros. Camera & Video Exchange

Excellent Advice, Prices and Reputation For 50 Years

209 Broadway (Rte. 110), Amityville, LI, NY 11701
1-800-262-4160 • 516-264-4160

NEW YORK

We have specialized in selling telescopes for over 10 years! See us for expert advice!

Johnson's Camera

6565 Kinne Rd. at Erie, DeWitt, NY 13214
315-446-0290

NEW YORK

Tracy-Adams Photo Supplies, Inc.

Largest Selection of Telescopes and Accessories in Upstate NY.

4508 Commercial Dr., New Hartford, NY 13413
315-768-6008

NORTH CAROLINA

Your quality Meade dealer in North Carolina

CC Sales/ Camera Corner

Phone: **800-868-2462**
Fax: **910-222-8011**
e-mail: **lroane@camcor.com**
2273 S. Church St., Burlington, NC 27215

NORTH CAROLINA

BALL PHOTO SUPPLY CO.

Your source for Meade products—sales, trade-ins, repairs.
Three Generations of Experience
85 Tunnel Rd., Innsbruck Mall, Asheville, NC 28805
Phone: **704-252-2443** Fax: **704-253-1457**

OHIO

PETE'S PHOTO WORLD

Competitive Prices! Great Service! Telescope expert on staff. Ask for Craig.
Serving the tri-state: OH, KY, IN.
7731 Beechmont Ave., Cincinnati, OH 45255
1-800-736-7383

OHIO

McALISTER CAMERA & VIDEO

Full Line Meade. Reputable Dealer With Competitive Prices. Call Eric For Advice.
588 W. Schrock Road
Westerville, OH 43081 (Columbus)
Phone: 614-794-1865

PENNSYLVANIA

The Camera Shop In Bryn Mawr

Suburban Philadelphia's
Photo & Optical Specialists

572 Lancaster Ave., Bryn Mawr, PA 19010
610-527-0300

PENNSYLVANIA

Specialists in telescopes! 13 stores—PA, NJ, DE—always friendly and knowledgeable.

CUTLER CAMERA

537 Easton Rd., Horsham, PA 19044
1-800-220-5727

PENNSYLVANIA

POCONO MOUNTAIN OPTICS

"Call or visit us—
Speak with dedicated amateur astronomers."
Corner of Route 307 & 502
104 N.P. 502 Plaza, Moscow, PA 18444
Orders: **800-569-4323** till 10 pm ET
Info: **717-842-1500** till 10 pm ET

SOUTH CAROLINA

Wonder Works

Friendly, helpful service!
Open 7 days a week.
280 W. Coleman Blvd., Mt. Pleasant, SC 29464
803-849-6757

SOUTH CAROLINA

Your Quality Meade Telescope Dealer for S. Carolina—10 Convenient Locations!

Jackson Camera & Video

Columbia: **803-776-7000**
Charleston: **803-766-2752**

TEXAS

Analytical Scientific

If it's a quality Meade telescope you're looking for, call us.
11049 Bandera Rd., San Antonio, TX 78250
210-684-7373 • 800-701-STAR
http:\\Astronomy-Mall.com

TEXAS

Land, Sea & Sky Unlimited

Complete sales and service of Meade telescopes. We are optical specialists.
3110 S. Shepherd Dr., Houston, TX 77098
713-529-3551
www.neosoft.com/~lsstnr

WASHINGTON

Meade Telescopes & Accessories

The Naturium

Northtown Mall, Spokane, WA
509-484-7014
Kitsap Mall, Silverdale, WA
360-698-3580

CANADA

PERCEPTOR

Friendly Service, Expert Advice, Low Prices, Full Meade Line, Delivery Across Canada
Brownsville Jct. Plaza, Box 38, Suite 201
Schomberg, Ontario L0G 1T0
905-939-2313 • Fax 905-939-8274

CANADA

LA MAISON DE L'ASTRONOMIE

Competitive Prices • Expert Service
7974 St. Hubert, Montreal, Quebec H2R 2P3
514-279-0063 • Fax **514-279-9628**
e-mail: rlotte@interlink.net
http://www.microid.com/maison.htm

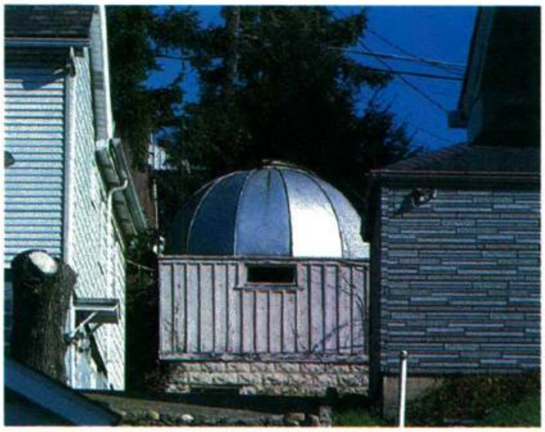
# TALKING BACK
FROM OUR READERS

Science Encounters Religion

RECENTLY I'VE GROWN concerned by the influence of religious fundamentalists on science teaching in the nation's schools. Last summer a newspaper article told of a Kentucky superintendent gluing pages of a science textbook together to prevent students from reading about the Big Bang theory, and teachers in some parts of Appalachia and the western United States reportedly fear losing their positions if they attempt to teach evolution. I urge your editorial board and your distinguished advisory board to consider covering this issue. At a time when the level of scientific knowledge of our nation's youth is already under fire, we can't afford roadblocks to learning. — *John Deering, Highland Heights, Kentucky*

Dave Stevenson's comments were compelling ("Carl Sagan Remembered," April, 1997). He mentioned those who look on Sagan with disdain. I confess to being one, though not for the reasons Stevenson suggested. Sagan was an excellent popularizer of science and knew his subject well. For this, I give both credit and thanks. However, his ventures into religion took him into an arena in which he was not an expert. Being a skeptic is healthy, but being too skeptical can be hazardous. Sagan stepped too often into a field he didn't understand. — *Lyle Porter, Albuquerque, New Mexico*

I was disappointed by John Turner's eulogy of Sagan (Letters, May 1997). As pastor of a small church, I am also the sponsor of the local high school astronomy club. I was offended by Turner's generalizations of those who hold to theories of our universe's origin that differ from his own. I enjoyed Sagan's dynamic approach to astronomy; he played a tremendous role in piquing my interest in a balanced study of cosmogony and cosmology. I encourage *Astronomy*'s staff and readers to keep a more open mind, practice tolerance, and strive for harmony as we work to understand the mysteries of our universe. — *Michael Kruger, Rangely, Colorado*


David L. Smith

The first-built aluminum dome observatory stands today.

Commemorate the Shiny Dome

When asked what an astronomical observatory looks like, the average person often describes a shiny metallic dome with a slit. In Pittsburgh, the original shiny dome still stands. The first of its kind in the world, it was designed and constructed of aluminum by Leo Scanlon and colleagues in the Amateur Astronomers Association of Pittsburgh in 1930; it is featured in *Amateur Telescope Making* (reissued by Willman-Bell, 1996). Recently, a proposal was submitted to erect an official state historical marker to commemorate the dome. The staff of the state program endorsed the proposal this year, but a review panel refused to endorse the marker. A second round of review begins July 1, and we're working with the state to increase our chances for approval. Notes of support from important amateur and professional

Astronomy®

KALMBACH PUBLISHING CO.

PRESIDENT
Walter J. Mundschau

EXECUTIVE VICE PRESIDENT
Gerald B. Boettcher

CORPORATE ART DIRECTOR
William R. Edgar

MANAGING ART DIRECTOR
Maureen Schimmel

ADVERTISING SALES DIRECTOR
Fred Hamilton

DIRECTOR OF CIRCULATION
Diane Morgenthaler

ADVERTISING SERVICES MANAGER
Sara Malin Everts

CIRCULATION MANAGER
Kit G. Hatcher

MARKETING MANAGER
Matt Mulder

CIRCULATION COORDINATOR
Elizabeth Hagon

ADVERTISING DEPARTMENT
(800) 558-1544

ADVERTISING SALES MANAGER
Dan Koehler dkoehler@astronomy.com

ADVERTISING SALES REPRESENTATIVE
Colby Waller cwaller@astronomy.com

AD SERVICES REPRESENTATIVE
Tracy Blonien tblonien@kalmbach.com

BLUE SKY PAGES REPRESENTATIVE
Pam Hagan phagan@kalmbach.com

NEWSSTAND DISTRIBUTION

U.S. AND INTERNATIONAL
I.C.D., The Hearst Corp., New York, NY 10019

CANADIAN
Telemedia Dist., Toronto, Ontario M4S 3B3

SPECIAL E-MAIL ADDRESSES

Ask Astro askastro@astronomy.com
Star Stuff starstuff@astronomy.com
Talking Back talking@astronomy.com
Hot Shots hotshots@astronomy.com
Customer Service customerservice@kalmbach.com
Ad Sales adsales@astronomy.com

Astronomy HOME PAGE
http://www.kalmbach.com/astro/astronomy.html

astronomers have been persuasive in gaining state support thusfar and additional letters, especially from historians, would be of tremendous help. Please send letters to me at 115 Will Run Road, Pittsburgh, PA 15238, phone (412) 648-1555. — *Barry M. Mitnick, Pittsburgh, Pennsylvania*

One Dad's Legacy

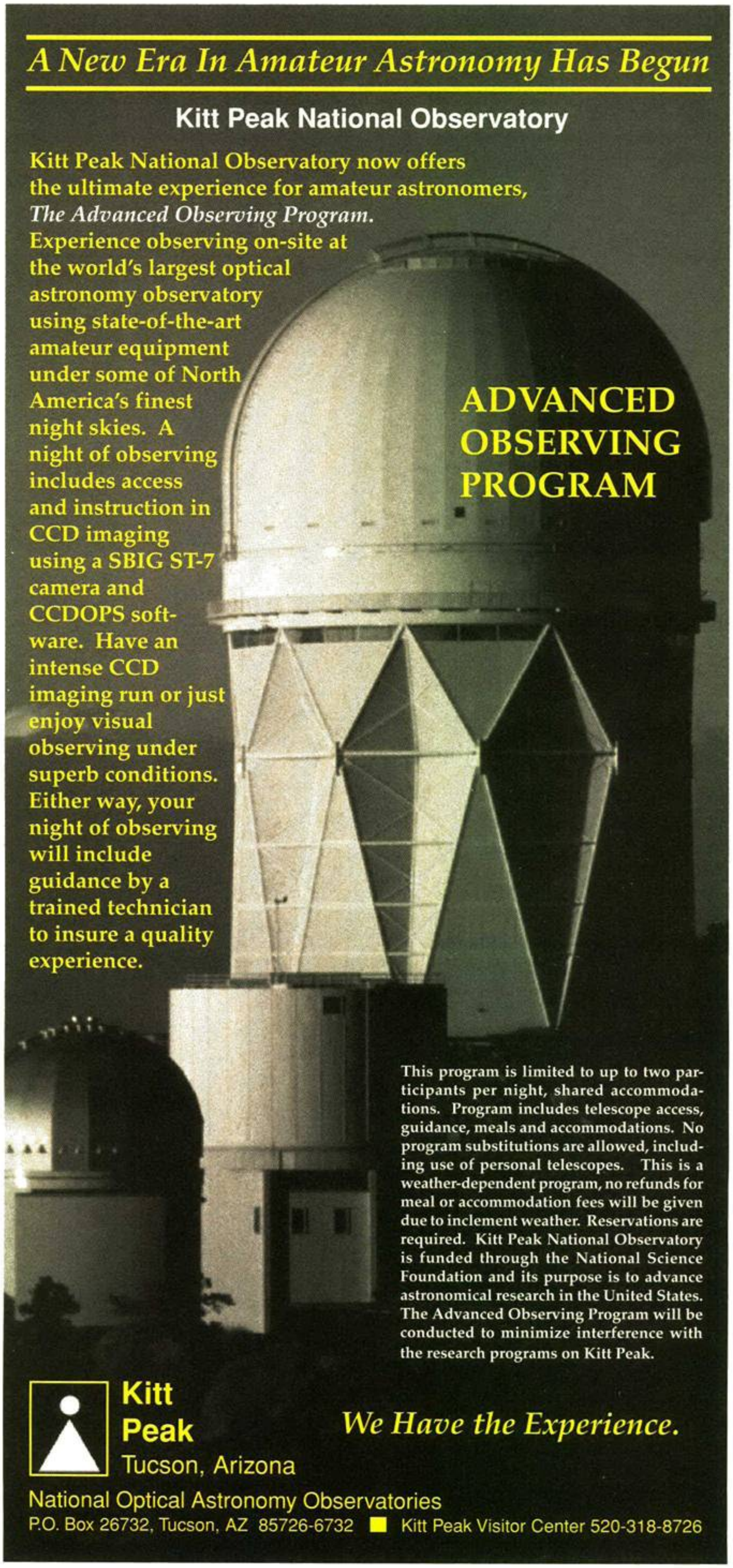
Until last summer, I was not even an occasional skywatcher. My father, an amateur astronomer and subscriber to *Astronomy*, tried unsuccessfully to peak my interest several times. His name was Nguyen Dinh Tu and he died of a heart attack last June, just after being elected to our Politbureau. His death was sudden, and left many things unfinished. Among them was a project to write a series of articles about astronomy, specifically Comet Hale-Bopp, for a popular scientific magazine here. As a memorial to my father, I have set forth to write those articles. In his papers and documents, I found a stack of *Astronomy* magazines and began to read them. I was excited by what I read and thrilled to observe such wonders as Orion's Belt, the Pleiades and Sirius for myself. Due to clouds in Hanoi, Hale-Bopp has only recently become visible. In addition to doing my own observing, I also have translated some of *Astronomy*'s articles into Vietnamese for my mother and friends. — *Nguyen Mac Ha, Hanoi, Vietnam*

A Slower Earth

"This Spaceship Earth" (Almanac, April, 1997) contained a factual error. Earth was reported to have an orbital velocity of 2,500 miles per minute, traveling its diameter in 1½ minutes. In actuality, it orbits at 1,111 miles per minute, and takes 7 minutes to travel its own diameter. — *Norman Peterson, Santa Monica, California*

Watch Those Stereotypes...

I was simultaneously startled, disturbed, and offended to encounter the demeaning remark directed toward the singer Madonna ("...finding four hot Jupiters was about as likely as Madonna taking an oath of celibacy.") in Robert Naeye's article on extrasolar planets in



A New Era In Amateur Astronomy Has Begun

Kitt Peak National Observatory

Kitt Peak National Observatory now offers the ultimate experience for amateur astronomers, *The Advanced Observing Program.* Experience observing on-site at the world's largest optical astronomy observatory using state-of-the-art amateur equipment under some of North America's finest night skies. A night of observing includes access and instruction in CCD imaging using a SBIG ST-7 camera and CCDOPS software. Have an intense CCD imaging run or just enjoy visual observing under superb conditions. Either way, your night of observing will include guidance by a trained technician to insure a quality experience.

ADVANCED OBSERVING PROGRAM

This program is limited to up to two participants per night, shared accommodations. Program includes telescope access, guidance, meals and accommodations. No program substitutions are allowed, including use of personal telescopes. This is a weather-dependent program, no refunds for meal or accommodation fees will be given due to inclement weather. Reservations are required. Kitt Peak National Observatory is funded through the National Science Foundation and its purpose is to advance astronomical research in the United States. The Advanced Observing Program will be conducted to minimize interference with the research programs on Kitt Peak.

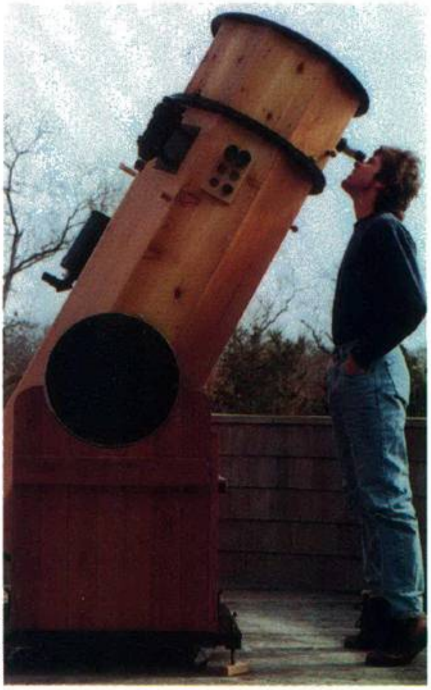
Kitt Peak
Tucson, Arizona

We Have the Experience.

National Optical Astronomy Observatories
P.O. Box 26732, Tucson, AZ 85726-6732 ■ Kitt Peak Visitor Center 520-318-8726

Astronomy (April, 1997). I am not a big fan of Madonna's, but it is my observation that she is generally attacked and/or made fun of for the same sexually extroverted behavior that is either unremarked-upon or openly admired in men. I doubt that you would print a so-called joke which dealt with racial stereotypes, so why do you permit the publication of a 'joke' that employs archaic and unfair stereotypes of female sexuality?

I have been an *Astronomy* subscriber for over 15 years, and this is the first time I have seen such a mean-spirited, irrelevant, unfunny jibe in your articles. I sincerely hope it will be the last. This type of sophomoric 'humor' is completely out of place in a science journal. — *Rachel Lerner, Blackwood, New Jersey*


Jeffrey Hines

Jeffrey Hines observes with his home-built telescope from eastern Long Island.

A Snazzy Home-Built Scope

I have a true love of deep-sky observing, and so built my own 17.5-inch telescope with enough light-gathering power to capture thousands of deep-sky objects, including exploding stars, stellar nurseries, and distant galaxies. I included castor wheels for easy transport, a counter weight system for balancing equipment, a finder scope to locate objects, a rotating tube to provide a comfortable viewing position, and a handy eyepiece holder to make eyepiece changes easier. — *Jeffrey Hines, East Hampton, New York*

Advertising In Astronomy

I have been a subscriber to your magazine for many years and can't help but notice a recent increase in advertising. Though I realize it's an important source of income for the magazine, I think it's detrimental overall. I would be more than willing to pay more per issue in order to reduce the amount of advertising. — *Ed Greenwald, Darien, Illinois*

Dan Koehler, Astronomy *Advertising Sales Manager, responds: While the number of advertising pages has indeed increased over the past year, so has the number of editorial pages. We maintain a near consistent split between editorial and ad pages; as it always has, the magazine contains 60 percent editorial and 40 percent advertising material.*

Many of our readers welcome the increase in ad pages as a sign that our hobby is attracting ever greater attention in the form of new ideas and products to enhance the field of astronomy. Additionally, ads in the magazine serve as an extension of editorial material, providing important and useful information about astronomical products.

As you mentioned, advertising revenue helps us produce Astronomy *each month. Unfortunately, unlike you, most readers are unwilling to pay a great deal more for subscriptions. To support our editorial, art, and production staffs, we must sell some pages in our magazine to advertisers. We go to great lengths to ensure that most ads are directly related to astronomical equipment and services specific to amateur astronomy in order to provide you with a great publication.*

Rotten Eggs

Just a short note about the photo caption on page 38 of the May 1997 issue. Sulfur dioxide (SO_2) is not what makes rotten eggs smell like rotten eggs. That particular olfactory experience comes to us courtesy of dihydrogen sulfide (H_2S) (which may also exist on Io). However, having worked with both compounds during laboratory simulations of Io's surface, I can assure you that neither compound is particularly pleasant to breathe. (SO_2 stings on the way down; it reacts with the water vapor in your throat and lungs to make sulfurous acid.) Cheers! — *Scott Sandford, Astrochemistry Laboratory, NASA-Ames Research Center*

Child's-Eye View of the Comet

On seeing Comet Hale-Bopp for the first time through my binoculars my young niece exclaimed with glee, "Oh, how lovely, it looks like a moon wearing a scarf." I couldn't have put it better myself. — *Ron Westmaas, Somerset, England*

Hold on to Your Binoculars

Your binocular holder construction project ("Stabilize Your Bino-Eyes," February 1997) caught my attention. Though not a new concept, yours was the first design I've seen where the binoculars and mirrors move about a common axis. I've designed a similar device in which the binoculars are clamped downward at a 60° angle. Instead of two mirrors, a single mirror is mounted in front of the objectives. This arrangement allows for a comfortable viewing posture, permits ready access for focusing, and the single mirror eliminates the need for collimation adjustments. — *Ralph Paramor, Cottesloe, Australia*

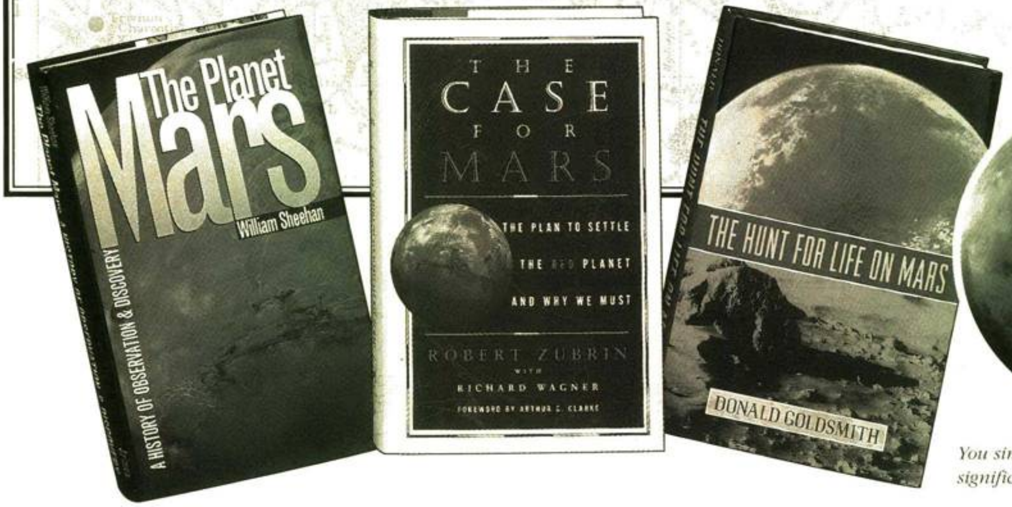
I suffer from a medical condition that makes it hard to hold binoculars for stargazing. I didn't like the bulky and expensive holders on the market so I adopted a lamp arm to do the job. A simple bracket ($0.30) replaced the lamp and it works wonderfully. Love your magazine! — *Jurek Zarzycki, Fremont, California* A

Astronomy *invites you to talk back. Send letters to* Astronomy *Talking Back, P.O. Box 1612, Waukesha, WI 53187; e-mail to talking@astronomy.com. Letters may be edited for space or clarity.*

Life on Mars? Explore the possibilities with . . .

The MARS SET—yours for only $4.95—

as your introduction to the **Astronomy Book Club**


The Planet Mars
A HISTORY OF OBSERVATION & DISCOVERY
William Sheehan
THE CASE FOR MARS
THE PLAN TO SETTLE THE RED PLANET AND WHY WE MUST
ROBERT ZUBRIN WITH RICHARD WAGNER
FOREWORD BY ARTHUR C. CLARKE
THE HUNT FOR LIFE ON MARS
DONALD GOLDSMITH

A $94.95 Value!

You simply agree to buy three more books—at significant savings—within the next 12 months.

The* MARS SET *explores the myths and mysteries concerning life on the Red Planet and examines modern controversies like:

- *Has life ever existed on the Red Planet?*
- *Can humans successfully colonize Mars?*
- *What can future investigations tell us about Martian evolution?*

THE PLANET MARS
A History of Observation and Discovery

By William Sheehan

"[W]e have only begun to awaken from our dream of Mars…with its great volcanoes, canyons, and dry riverbeds, Mars remains a fascinating, even if lifeless, world."—W. Sheehan

From the Egyptians and ancient Greeks to the eighteenth century work of Herschel and Shroeter, to upcoming missions of the *Mars Global Surveyor* (MGS), Sheehan analyzes every significant study and finding about the Red Planet. In addition, you'll examine:

- The debates about dry seas, canals, polar ice caps, and ancient Martian civilizations
- Asaph Hall's discovery of Mars' satellites—Phobos and Deimos
- The *Viking* tests for evidence of life

270 pages. Publisher's Price: $45.00

THE CASE FOR MARS
The Plan to Settle the Red Planet and Why We Must

By Robert Zubrin with Richard Wagner

While colonization of Mars may be technically feasible, costs are an important issue. This volume presents detailed plans to make the venture affordable, including descriptions of the hardware, fuel needs, pitfalls, and much more. Find out:

- How separate return craft could synthesize their own fuel from the Martian atmosphere
- How settlers could use the iron-rich soil for basic building materials
- What hazards await the pioneers, including solar flares, cosmic rays, zero gravity, and dust storms

328 pages. Publisher's Price: $25.00

THE HUNT FOR LIFE ON MARS
By Donald Goldsmith

In August 1996, the scientific community was drawn into a controversy when NASA claimed that an ancient meteorite from Mars bore evidence of primitive life. Scientists had to answer some questions before this meteorite could be considered proof of ancient life on Mars:

- Did the meteorite actually come from Mars?
- Was the sample contaminated?
- Could a nonliving process produce the same effects?

But, as these questions were answered, more arose. Discover how future missions to Mars may reveal the answers.

267 pages. Publisher's Price: $24.95

Whether you're a professional astronomer or amateur enthusiast, the ASTRONOMY BOOK CLUB offers you the finest astronomy materials available. You'll enjoy practical observing handbooks, atlases and how-to manuals, as well as general texts, in-depth investigations into topics on the frontiers of astronomy and astrophysics, and popular guides covering the latest discoveries. All books are available to you at significant savings, with prices starting as low as $9.95.

MEMBERSHIP BENEFITS In addition to getting the MARS SET for just $4.95 when you join, you keep saving substantially with discounts of up to 50% off the publishers' prices on books you choose to purchase. • Also, with your first purchase of one regular selection, you'll earn Bonus Credits you can use to save even more. • When you qualify as a Preferred Member, you'll earn double Bonus Credits and enjoy other special benefits. • Moreover, our books are always identical to the publishers' editions. You'll never receive an "economy edition" with inferior paper and bindings from us. • At 3-4 week intervals (12 times per year), you will receive the Astronomy Book Club News, describing the coming Main Selection and Alternate Selections, together with a dated reply card. • In addition, up to three times a year, you may receive offers of Special Selections which will be made available to a group of select members. • If you want the Main Selection, do nothing, and it will be sent to you automatically. • If you prefer another selection, or no book at all, simply indicate your choice on the card and return it by the date specified. • You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.

NEWBRIDGE

©Newbridge Communications, Inc.,
a K-III Education Co.

Astronomy 7/97

If reply card is missing, please write to the Astronomy Book Club, Dept. L-DV4/00652, 3000 Cindel Drive, Delran, NJ 08370-0001, for membership information and an application.

IDENTI-VIEW™

PREMIUM GLASS SOLAR FILTERS

- **SAFE** • **HIGH QUALITY**
- **STRICT CONTROL STANDARDS**
- **LIMITED LIFETIME WARRANTY**

CLASS "A"

Color band - blue. Class "A" filters are made with the same premium quality polished glass and multi-alloy coating as Class "B" An additional steel alloy added to the coating process makes our Class "A" filters extremely scratch and fade resistant. Excellent for visual and photographic use. Light transmission is 1/1000th of 1%.

CLASS "B"

Color band - white. Class "B" filters are made with polished glass and multi-alloy coating. These filters offer great durability and will provide many years of service and enjoyment with normal use. Can be used visually and for photography. Light transmission is 1/1000th of 1%.

CLASS "C"

Color band - red. Class "C: filters are specifically coated to a lighter density (ND-4). They are for photographic use only. This filter is intended for use by professionals and serious hobbyists. Light transmission is 1/100th of 1%.

ORDERING INFORMATION

1. State scope brand and model number, aperture and outside diameter with filter class and price.
2. Make check or money order payable to J.M.B. Inc. All foreign checks must be payable through a U.S. bank.
3. Shipped free within the continental United States. All others add $5.50 Shipping and Handling per filter. Michigan residents add 6% sales tax. Allow 2-3 weeks for delivery.

For more information see our ad in
EXPLORE THE UNIVERSE 1997

VISA **J.M.B. INC.** MasterCard
20762 Richard • Trenton, MI 48183
(313) 675-3490 • FAX (313) 692-5772

"Imitated but never duplicated"

It found C/1996 B2, Comet Hyakutake

Models: 25x150 standard or ED optics; the incredible 40x150 ED and 25x150 ED with 45° viewing.

Even if it's just a 10th-magnitude smudge, as C/1996 B2 was when discovered, you can still find your own comet with Fujinon's 25x150 and 40x150 — the most powerful binoculars in production. Six-inch objective lenses, EBC coated high brightness optics and US Mil Spec construction make these the best astronomical binoculars in the universe. And ultra high performance ED optics are available in models with straight or 45° angle viewing.

For greater portability and convenience, Fujinon's Polaris™ binoculars, with **better than 95% light transmission**, give you the brightest, high-resolution images possible. Their flat-field, distortion-free optics increase the useful field area more than 40% by eliminating defocused star images near the field stop. You enjoy the widest, sharpest and brightest high-contrast views of globular clusters, galaxies and delicate nebulae detail. All with outstanding balance and ultra-long eye relief. They're waterproof, meet US Mil Specs and are backed by Fujinon's lifetime limited warranty.

Polaris 16x70 FMT-SX

Polaris models: 7x50, 10x70 and 16x70. Carrying cases are standard, filters and a tripod adapter are optional.

For more information, contact:

FUJINON INC.
10 High Point Drive
Wayne, NJ 07470
(201) 633-5600 FAX (201) 633-5216

FUJINON

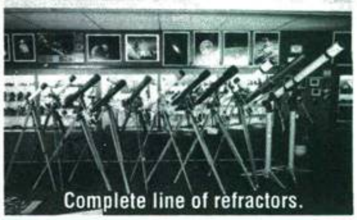
Scope City

Largest, Most Complete Optical Supermarket in the World

Meade Dealer

Parks 10"
f/3.5 & f/13.5
Dual System
H.I.T. Telescope

Complete line of TeleVue products.



WORLD'S LARGEST SELECTION OF BINOCULARS

SAVE UP TO 45%

ON TELESCOPES, BINOCULARS & ACCESSORIES. EXPERT HELP.

See the latest innovation in astronomical equipment

MAIN OFFICE
730 Easy St.
Simi Valley, CA 93065
TEL: (805) 522-6646

SIMI VALLEY
730 Easy St.
TEL: (805) 522-6646

COSTA MESA, CA
3033 S. Bristol
TEL: (714) 957-6900

SHERMAN OAKS, CA
14324 Ventura Blvd.
TEL: (818) 789-5805

SAN DIEGO, CA
4766 Clairemont Mesa Blvd.
TEL: (619) 277-6686

SURPLUS STORE
COSTA MESA, CA
3033 S. Bristol
TEL: (714) 957-6900

SCOPE CITY / MAIL ORDER
P.O. Box 440 • Simi Valley, CA 93065
TEL: (805) 522-6670
FAX: (805) 582-0292
Catalog package $7 (refundable with purchase).
Free price list.

BUY • SELL • TRADE • SERVICE

Anyone can sell you a telescope.

We'll sell you the right scope.

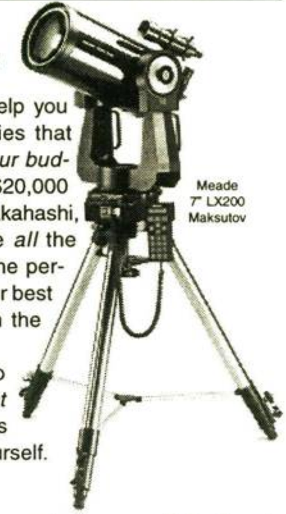
Authorized Meade Dealer

Hardly a day goes by that we don't get a note like the one reprinted below, or a call that goes something like this: "Your ads are right. So and so on the East Coast advertises low prices – but they don't have what I want in stock, they couldn't answer *any* of my questions, and they wanted my credit card number before they'd even *talk* to me. They said if I wanted to ask questions, I should call the manufacturer . . . and then they hung up on me!" One of our customers added, "If I wanted that kind of abuse, I would have called my ex-wife."

You need more than a camera store clerk with a price list and a wild guess to help you pick the right scope. You need someone who will take the time to listen to what *you* need, someone with the experience to help *you* get the most scope for your dollar. We've been helping people choose the right scope since 1979 at ***astronomics***.

We *have* the experience to help you pick the scope and accessories that best fit your needs . . . *and your budget*. With scopes from $299 to $20,000 – Meade, Celestron, TeleVue, Takahashi, Questar, and more – we have *all* the right stuff. We may not have the perfect scope for everyone, but we'll do our best to help *you* pick the right scope from the more than 75 models we carry.

astronomics. No hard sell. No guessing. Just honest advice, the *right* telescope . . . and a good price. Call us at (405) 364-0858 and find out for yourself.



Meade 7" LX200 Maksutov

The right telescope might be a Meade . . .

Whether it's the computerized 7" **LX200 Maksutov** above; the new 8" **LX10** or 3.5" **ETX**; or just an accessory like an eyepiece, a filter, a Barlow, or a Magellan computer – if Meade is shipping it for a dealer to keep in stock, the chances are good we *have* it in stock.

Meade prices are about the same anywhere you call. So there's no sense in buying from a dealer who charges your credit card, then makes you wait until he gets around to ordering what you want. Not when you can get what you want *right now* . . . from ***astronomics.***

The right telescope might be a Celestron . . .

We have Celestron's DC-drive **Celestar 8** in stock – the lowest-priced complete 8" Schmidt-Cassegrain made. It has the same optical quality as the most expensive Celestron, which may be why it has become one of our all-time best-sellers. We average one new and very satisfied customer per day for this best-buy scope.

We have the new 8" **Celestar 8 Deluxe**, with 9 x 50mm finder, 26mm Plössl eyepiece, built-in PEC dual-axis drive corrector, dec motor, hand control, separate wedge and tripod, and more. Plus, it's cordless – it all runs off a pair of inexpensive 9 volt transistor radio batteries!

We keep Celestron's **Pixcel 255** CCD autoguider/imager in stock. It's an affordable and *very* user-friendly plug and play CCD camera that will have you taking great CCD images in less than an hour through any brand SCT. The Pixcel 255 is made exclusively for Celestron by SBIG.

Celestron 8" Star Hopper Dobsonian

$499

Get a 10mm eyepiece, 2x Barlow, Telrad finder, and CD-ROM for only $49.95 when you buy this 8" Dob

It might be a Takahashi or TeleVue, or the right accessory . . .

We have **Takahashi fluorite/ED refractors** in stock – the 3.1" **FS-78EN** on the EM-2 mount; the 4" **FS-102H** on the EM-10 dual axis mount; the 5" **FS-128SE** on the EM-200 mount, and more.

We have limited quantities of the new **TeleVue TV-101** 4" f/5.6 apo refractor in stock. Similar to the famous **TeleVue Genesis**, which is also in stock, the 101 uses the same exotic glasses as TeleVue's $5600 5.5" **Custom 140** for the ultimate in fast focal ratio 4" optics.

We have **Megastar** version 3.0 CD-ROM observing software that includes the 19,000,000 object Hubble Guide Star catalog, planets, comets, asteroids, full LX200 scope control, customizable screen display and chart printing – and a bargain price of only $129!

We have the **Kendrick Dew Remover System** in stock. It includes flexible dew caps and heaters for eyepieces, finders, and telescopes. From the Telrad to the 3.5" Meade ETX to the Celestron CG-14 . . . and all scopes in between. Heaters to keep dew from frying your laptop and cold from slowing your LX200 hand control, too.

We have the **Optec f/3.3 Maxfield** telecompressors in stock, starting at $225. They're the wide-field telecompressors that convert an f/10 SCT into an f/3.3 speed demon for CCD imaging.

We have **ScopeSaver** observing tables for your LX200 tripod – and **ScopeSaver Jr.** alignment plates that make it a cinch for one person to mount an LX200 on its tripod safely. *And we have more!*

Our free catalog tells how to pick the right Celestron, Meade, Questar, Takahashi, or TeleVue.

Call us at (405) 364-0858, or E-Mail us at Compuserve or AOL, for your *free* copy of our catalog 97AST covering all of the telescopes and accessories we stock – from Celestron, DayStar, Edmund, JMI, Kendrick, L-5 Systems, Lumicon, Meade, Optec, Questar, Rigel Systems, SBIG, Software Bisque, Takahashi, TeleVue, and more. We'll include our 8-page guide on how to pick the right scope and your discount prices on the hundreds of products we carry (sorry, U. S. sales only). The catalog is yours for only the cost of a one minute phone call. The information we send will make it the most useful and informative one minute call you'll ever invest in astronomy.

I certainly wish all the companies we deal with in life could be more like yours.

Customer Quote of the Month #65

astronomics

Our 19th year of friendly service, good advice, and money-saving prices.

2401 Tee Circle, Suites 105/106, Norman, OK 73069

Toll-Free Order Line: **(800) 422-7876** Catalogs/Questions/Advice: **(405) 364-0858**

24-Hour FAX: (405) 447-3337 Compuserve: 102603,3054 America On-Line: okastro@aol.com

10 AM to 5 PM CST, Mon. thru Fri. We accept Mastercard, Visa, Discover, Optima, and American Express. U. S. sales *only*.

No credit card surcharge. $5.95 minimum freight. Restocking fees apply to returns for credit and to merchandise returned in used or damaged condition.

PLANETARY ASTRONOMY

Hubble: A Weather Satellite for Mars

Sharpest HST views ever of Mars

▶ Since 1990, two teams of astronomers led by Phil James of the University of Toledo and David Crisp of the Jet Propulsion Laboratory have been using the Hubble Space Telescope as a martian weather satellite. In the last year, the planet's changing weather patterns have shown a rapidly shrinking polar cap made of dry ice, an increasingly cloudy atmosphere, and a greater variety of dust storms in the north polar regions.

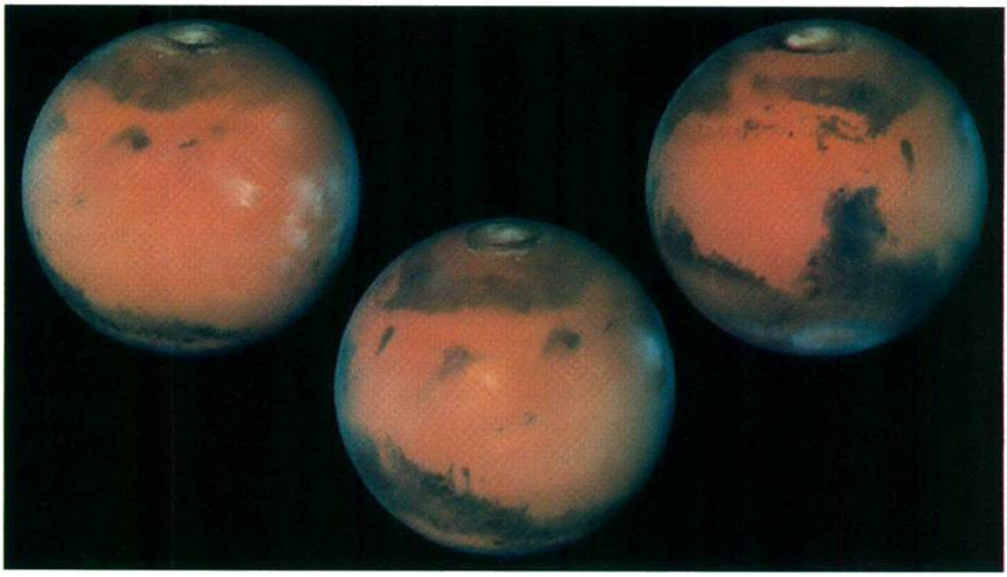
The most spectacular photos, taken on March 10 when Mars was near its closest point to Earth in the past two years, show the Red Planet during an entire day's rotation. White ice clouds can be seen drifting across the top of the gigantic volcanos of the Tharsis Plateau (the eastern middle latitudes of the left-hand picture) as well as in the Hellas impact basin (the southern latitudes of the right-hand picture).

Also visible is the dark sea of sand dunes that surrounds the northern polar cap. The cap itself then consisted mostly of water ice, its upper layers of frozen carbon dioxide having evaporated during the planet's long spring.

The scientists speculate that the increasing number of dust storms indicates a large planetwide storm may develop sometime in the coming year. However, as Jim Bell of Cornell University notes, "The planet's weather has not behaved as expected in the last decade."

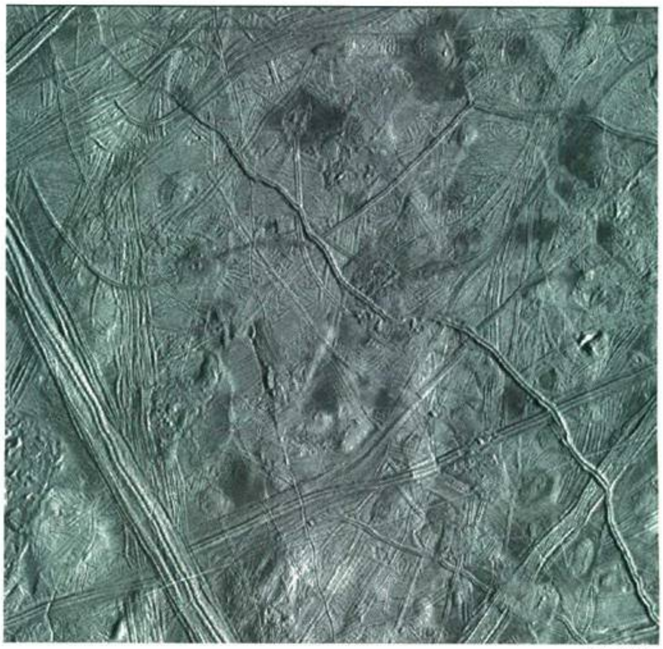
Hubble will continue to take pictures until October, providing valuable support for both the Mars Pathfinder and Mars Global Surveyor spacecraft. After this Mars lies too close to the sun in our sky for Hubble to be aimed at it, making further observations impossible until late 1998.

— Robert Zimmerman



David Crisp (JPL), the WFPC2 Science Team, and NASA

Hubble captured Mars in mid-March, near the time of its closest approach to Earth and just as summer was beginning in the planet's northern hemisphere. The three pictures were taken during three HST orbits separated by about six hours to show a full rotation of the planet.



NASA/JPL

A moderate-resolution view shows that Europa's icy crust has been modified extensively by fracturing and the formation of ridges. This view was taken from a distance of 11,000 miles (17,700 km).

GALILEO MISSION

An Ocean on Jupiter's Moon Europa?

▶ Planetary scientists looking at the latest images of Europa are more convinced than ever that a subsurface ocean once existed, and may still, beneath the icy crust of the jovian moon. Taken by the Galileo spacecraft in

JMI NEW PRODUCTS SHOWCASE!!

- Systematically creating new products you want and need.

I am impressed beyond words (with JMI)! Your company truly is producing NEXT GENERATION EQUIPMENT. My next large instrument will be from JMI! *Robert N. - Idaho*

MOTOFOCUS

For ultrafine vibration-free electric focus.
Installs in Seconds.
No Tools Required.
Smallest Motor Ever.

MEADE
MOTOFOCUS
F S
JMI
MODE ENTER UP DOWN
NGC-miniMAX
JMI

1 (800) 247-0304

Order line for ETX Accessories
WE DO NOT SELL ETX SCOPES

MOTOFOCUS
JMI *Exclusive!!*
$99.95 (4)
with
Variable Speed Hand-Control

Let JMI Computers Guide You Through the Universe
Find Objects Fast & Easy

JMI
Exclusive!!
Easy Installation

Order MOTOFOCUS & MOTODEC at the Same Time and Save Big - $169.95 (5) - includes one dual control hand unit (Reg. $10 upgrade)

Our popular "MAX" computer units are ready to use with your choice of over 100 models of commercial telescopes. They feature high resolution (0.09˚) optical encoders and do not require polar alignment or leveling! Easily find any object in the computer's database, even add your own! Ask for our free encoder installation instructions detailing how our encoders mount to your own telescope.

NGC-microMAX, 245 objects	**$399** ($6)
NGC-miniMAX, Planets, polar align help, 3900+ objects	**$529** ($6)
NGC-MAX, Planets, polar align help, RS-232, identify mode, 12,000+ objects	**$699** ($6)

New JMI *Exclusive!!!*

Foam-lined Carrying Case for ETX

Travel in Style while Protecting Your Investment.

- Professional Die-Cut Foam Lining -Top & Bottom (No cubes to fall out)
- Compartments to hold 5 to 6 eyepieces, barlows, hand controls, etc.
- Compartments to hold a MAX, mini-MAX, micro-MAX
- Keys included to Secure ETX & Accessories.

Get Organized for Only $109.95 (7)

MOTOFOCUS
JMI

Dual-control Hand Unit shown for powering the MOTOFOCUS & MOTODEC

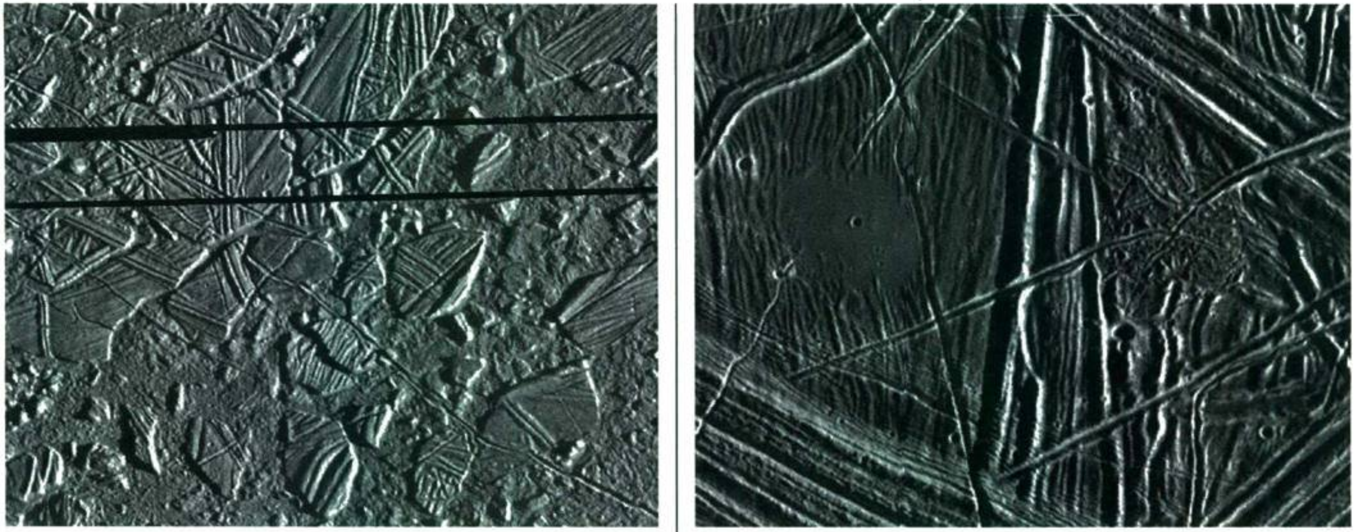
Shown with Declination Encoder Installed

MOTODEC
JMI *Exclusive!!*
$99.95 (4)
with
Variable Speed Hand-Control

MOTODEC

Variable Speed for Slewing & Guiding in Declination
Installs in Seconds. No Tools Required.

Jim's Mobile Inc. • 810 Quail St. Unit E • Lakewood, CO 80215 • Orders: 800-247-0304 • Info: 303-233-5353 • FAX: 303-233-5359



NASA/JPL

Europa's "ice rafts" — parts of the icy crust that have broken apart and drifted into new positions, superficially resembling pack-ice in Earth's polar seas during spring thaws — appear in a close-up view taken from 3,320 miles (5,340 km) away (left). The rafts range up to 8 miles (13 km) across. A flat smooth area about 2 miles (3 km) across shows up on the left-hand side of another close-up view (right). This area apparently formed when a fluid from the interior erupted onto the surface, burying sets of ridges and grooves that remained unaffected to the east. Several small craters also show up in this region.

February when it flew just 363 miles (586 kilometers) above the moon, the images show chunky ice rafts and relatively smooth, crater-free patches on the surface. Scientists continue to argue, however, about just how old the surface is.

"The blocks of ice appear similar to those seen on Earth's polar seas during springtime thaws," says Ronald Greeley, a member of the Galileo imaging team. "The size and geometry of these features lead us to believe there was a thin icy layer covering water or slushy ice, and that some motion caused these crustal plates to break up." "These rafts appear to be floating and may, in fact, be comparable to icebergs here on Earth," adds Michael Carr, another imaging team member. "The puzzle is what causes the rafts to rotate."

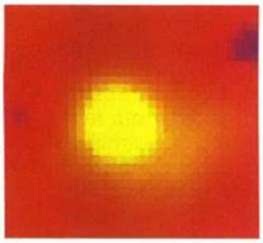
The new images have also sparked a spirited debate over the age of Europa's surface. Imaging team member Clark Chapman sides with those who think the smoother regions with few craters indicate a much younger surface than previously believed. (The older a surface, the more time it has had to collect impact scars.) "We're probably seeing areas a few million years old or less, which is about as young as we can measure on any planetary surface besides Earth," he says. "Europa's extraordinary surface geology indicates an extreme youthfulness — a very alive world in a state of flux."

Carr sees things differently, however, putting the age of the surface at closer to one billion years. "There are just too many unknowns," he says. "Europa's relatively smooth regions are most likely caused by a different cratering rate in the vicinity of Jupiter and Earth. For example, we believe that both Earth's moon and the jovian moon Ganymede have huge craters that are 3.8 billion years old. But when we compare the number of smaller craters superimposed on these large ones, Ganymede has far fewer than Earth's moon. This means the cratering rate at Jupiter is less than the cratering rate in the Earth-moon system."

Scientists hope that future Galileo observations will help to answer some of these lingering questions. A key finding would be signs

HIGH-POWERED BLASTS

Smoking Gun for a Gamma-Ray Burst?



Kailash Sahu (STScI) and NASA

Seen close-up, the gamma-ray burst's possible counterpart shows as the bright emission while the apparent host galaxy appears as extended emission to its right and below.

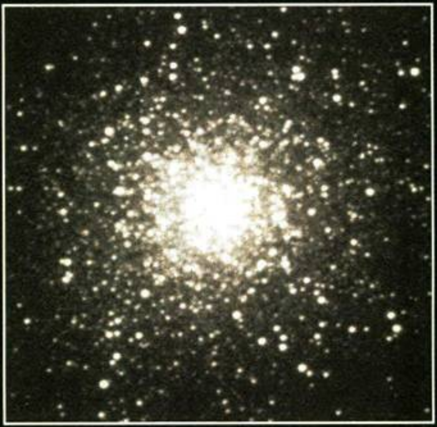
▶ The question of where gamma-ray bursts — intense explosions of extremely high-energy photons that bombard Earth on average about once a day — originate has baffled astronomers since they were discovered three decades ago. Some believe the bursts arise in our own galaxy, probably in a vast halo that extends well beyond the visible part of the galaxy. Others argue that they occur deep in the cosmos, in distant galaxies spread throughout the universe. Now a recent discovery suggests that gamma-ray bursts lie at great distances.

The two main problems in pinning down where bursts originate are that the positions of most of the bursts are known only approximately and not a single counterpart had been seen at any other wavelength. When astronomers searched in the poorly defined areas, they found dozens or even hundreds of potential host objects, but saw no

SBIG
ASTRONOMICAL
INSTRUMENTS

IN EVERY FIELD THERE IS A LEADER

SBIG HAS COMBINED IMAGING AND AUTO-GUIDING



M13 Globular Star Cluster contains an estimated one million stars with a luminosity of over 300 thousand times the sun, and a mass equal to half a million solar masses. CCD images give the impression of incredibly thick crowding and suggest that the stars are packed virtually in contact. This is an illusion, due to the vast distance of the group and the merging of the many stars. The central region covers an area some 100 light years across, or roughly a million cubic light years in volume. Assuming that a million stars populate this region, it is evident that the density is no greater than about one star per cubic light year. Approximately 100 similar globular clusters are now known, seemingly surrounding our galaxy on all sides. When the distribution of these objects is plotted, it is found that they form a nearly spherical system and that the center of this system is identical with the center of our Galaxy. This remarkable 180 second ST-7 CCD image was taken at the prime focus of a 7-inch, f/9, APO through an infrared filter utilizing the self-guiding mode. Courtesy of *Brad Ehrhorn*.

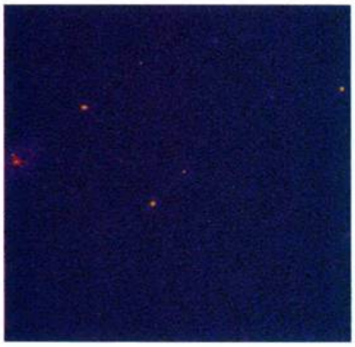
COMPARE

	Model ST-7	**Model ST-8**
Resolution	765 x 510 pixels	1534 x 1020 pixels
Total Pixels	390,000	1,500,000
CCD area	6.9 x 4.6 mm	13.8 x 9.2 mm
Celestron C-8 f.o.v.	12 x 8 arcminutes	24 x 16 arcminutes
Software	Windows & MSDOS	Windows & MSDOS
Color Filter Wheel	CFW-8	CFW-8

For catalog or demonstration disk contact:

SANTA BARBARA INSTRUMENT GROUP
P.O. Box 50437 1482 East Valley Road #33
Santa Barbara, CA 93150
Phone (805)969-1851 FAX (805)969-4069
e-mail: sbig@sbig.com Home address: www.sbig.com

SBIG
ASTRONOMICAL
INSTRUMENTS


Kailash Sahu (STScI) and NASA

The optical counterpart to a gamma-ray burst? That's what astronomers think they have in the 26th-magnitude dot at the center of this Hubble Space Telescope image.

indication of which might be the actual host.

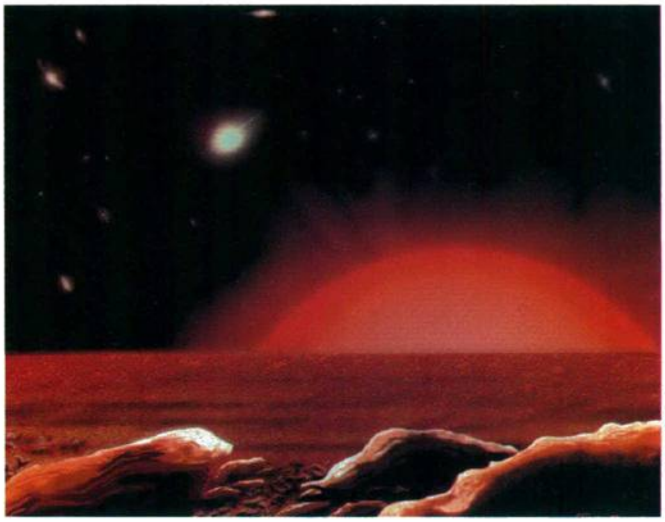
That all changed on February 28. That's when a new Italian-Dutch satellite named Beppo-SAX, launched less than a year before, detected a gamma-ray burst in the constellation Orion. Fortunately, the satellite also contains a number of x-ray cameras with much higher-resolution. Just eight hours after the burst, the satellite had pinpointed an x-ray source in the same vicinity that had not been there before.

As the x-ray source quickly faded, astronomers around the world pointed their telescopes in the burst's direction — and glimpsed an object glowing faintly in visible light. Better yet, the object appeared to lie in a faint galaxy. Was this the gamma-ray burst's fading ember and the first direct link between a burst and a galaxy?

Although the case looks strong, the jury has yet to reach a verdict. After all, there's no guarantee that the x-ray source was the afterglow of the original gamma-ray burst. And the object could just lie along the same line of sight as the galaxy and not reside in the galaxy.

As if to drive that point home, observations made just before this issue went to press seemingly caused the pendulum to swing in the opposite direction. A team of astronomers led by Patrizia Caraveo of the Institute of Cosmic Physics in Milan, Italy, examined two Hubble Space Telescope images of the counterpart taken 12 days apart and found it to be moving. Only objects relatively close to Earth — in the Milky Way Galaxy — could move as quickly as this object appeared to. And observations made with the 10-meter Keck II Telescope revealed that the extended emission had apparently faded below the telescope's detection limit — certainly not the behavior expected of a distant galaxy.

In science, certainty rarely comes from just one observation. But Beppo-SAX continues to orbit Earth and should see many more gamma-ray bursts. If they can also be linked to x-ray sources and then to distant galaxies — or to objects apparently moving in our own galaxy — the case may soon be solved.


James Gitlin (STScI)

A dull red glow floods the desolate landscape of a hypothetical planet orbiting an intergalactic red giant star in the Virgo Cluster. Recent Hubble observations found hundreds of these stars (and imply that a trillion more stars may exist in the cluster). In this artist's conception, the nighttime sky contains only the dim fuzzy glows from the cluster's elliptical and spiral galaxies — individual stars lie too far away to be seen. The brightest galaxy is the giant elliptical M87, with its visible jet of high-speed particles.

of current activity, such as an erupting geyser, or evidence of changes in Europa since the time of the Voyager flybys in 1979. In November, Galileo returns to Europa for the final encounter of its primary mission. However, eight more flybys are planned as part of the spacecraft's two-year extended mission.

VIRGO CLUSTER

The First Intergalactic Stars

▶ Recent observations with the Hubble Space Telescope suggest that up to a trillion stars may be drifting aimlessly through the dark recesses of intergalactic space in the Virgo Cluster of galaxies. The isolated stars — stellar outcasts ripped from their home galaxies during encounters with other galaxies early in the cluster's history — lie more than 300,000 light-years from the nearest big galaxy.

A team of astronomers led by Harry Ferguson of the Space Telescope Science Institute found the stars while photographing a "blank" area of sky in the Virgo Cluster. The area lies in the vicinity of the giant elliptical galaxy M87, but far enough away to be outside that galaxy's halo.

The astronomers counted about 600 stars, all bright red giants, down to a magnitude of 27.8. Because this class of star is rare, presumably many fainter stars — perhaps as many as 10 million — lie in the same field but remain below Hubble's sensitivity. Extrapolating these numbers to the entire cluster suggests that up to a trillion of these lone stars

Astronomy
Software

37 Programs to Help You!

☐ **SkyLights**™ Explore the Sky through Windows! For any date from 4700BC to 9999AD see Sun, Moon, planets and stars, plus all Messier objects and hundreds of selected NGC and IC objects (galaxies, clusters, etc.). Skylights is very easy to use and takes full advantage of the Windows environment, such as printer support and moveable information windows. Track an object across the sky using time steps you specify. Get detailed information by clicking on an object, such as RA & Dec., Alt & Azm, geo & heliocentric Lat & Long, rise and set & more. Database of world cities lets you pick any observing site, add your own. Database of sky events like eclipses, occultations, etc. is included, just click and observe. Has three information windows you can toggle on or off. Zoom in or out. Many controls to customize program the way you like! IBM, Win 3.1 or 95 **$79.95**

☐ **AstroVizier**™ Calculates precise positions for Sun, Moon and all planets and provides views as seen from Earth to show orientation of body and other details of physical ephemerides. See rings of Saturn in correct perspective, positions of planetary poles & equators, central meridians, belt system data for major planets, arc second sizes, phases, more! For observing, research. IBM **$39.95**

☐ **Satellite Pro**™ - Earth satellite tracking for high accuracy ephemeris & simultaneous propagations & for optical & radio tracking. Flies up to 200 satellites simultaneously. Comes with nearly 6,000 satellite orbital element sets; info for free updates. Displays Earth ground tracks, sky maps with stars, planets, Sun, Moon. Satellite RA/Dec, slant range, range rate, intersatellite range, phase angles, height, altitude & sky velocities, AOS time & pass duration. IBM with harddrive **$149.95**

☐ **AstroCalc Super**™ Input time, date & lat./long. & get for Sun, Moon & planets: Right Asc./Dec., Alt/Azm, Ecliptic Lat./Long., Angular size, Fraction Illum., Elongation, Rise/Set Times, Distances from Sun & Earth, Sidereal Time, Twilight Times, Helio and Geocentric Data. Automatic repetitive calculations(solar/planetary positions or any other data for every hour or day, etc.). Output to text file or printer. Plots of Sun, Moon & Planets to screen, printer. Helio & geocentric plots of longitude & distance or lat. & dist., RA & Dec. or alt & azm. IBM **$79.95**

☐ **AstroCalc**™ **for Windows** V2.0 Like above but adds 16 search functions, 6000 location database, save/display graphic plots, calendar, more! IBM, Win 3.1 or 95 **$129.95**

☐ **StarMaster**™ Great companion for learning the sky! Explore sky to see constellations, Sun, Moon, planets plus thousands of stars and deep-sky objects. Provides descriptions of constellations, major stars, etc. SkyNow! function tells planets, bright stars currently visible. Quiz mode teaches all about the sky! IBM Win 3.1 or 95 **$59.95**

☐ **LodeStar Plus**™ Powerful, versatile tool to bring the universe to your computer, from 9999BC to 9999AD for any location. Includes 9,000 stars, all 7840 NGC objects, Messier objects, Sun, Moon & planets. View from 180 deg. to 0.18 deg See solar/lunar eclipses, planetary conjunctions, occultations, transits. Get Alt/Az, RA/Dec. Find or identify any NGC object, star or planet. For high accuracy, calculate precession, refraction, aberration, nutation, parallax. Pick from 300 printers. IBM **$99.95**

☐ **EclipseComplete 2.0**™ Plots solar eclipses on variable scale world maps (conic, rect., polar), plus detailed numerical data. Specify center of map & size by giving lat. & long. limits. Central line of totality is plotted & lines for north/south limits. Countries & rivers plotted. Add cities to maps. Output to screen/printer. Plots lunar eclipses & data. IBM **$129.95**

☐ **SunTimes**™ **Windows** Monthly sunrise/set tables for any year/location. Screen, printer, file. Twilight times, max. alt., hrs. sun, azm. of rise/set. Daily sky plots. IBM **$59.95**

☐ **MoonTimes**™ **Windows** Like above for Moon. Rise/set times, phase & azimuth at rise/set, plots. IBM **$59.95**

MasterCard **Order Today!** VISA

1-800-533-6666

FAX: 412-422-9930 E-mail: mail@zephyrs.com
For Info, or Outside USA, Call 412-422-6600
Order by phone, FAX, mail, E-mail. Check, M.O., or credit card (# & exp. date). $5 shipping, $8 outside US/Can. In PA add 7%.

Web Site: www.zephyrs.com

Zephyr Services

The Leading Astronomy Software Publisher

ZS
1900 Murray Ave. Dept. B
Pittsburgh PA 15217
FREE CATALOG

Our 16th Year

Image the Home Planet

PC HF Facsimile Plus $129

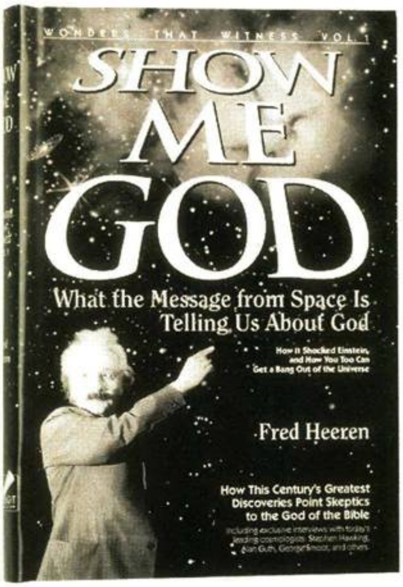
Complete shortwave systems including radios, antennas, software and interfaces are as little as $369. Complete systems for direct satellite reception start at $529. Call or write for our free product catalog.

Every day a fleet of Earth orbiting weather satellites image our planet. These images are relayed over shortwave radio and transmitted directly from the satellites. SSC makes the hardware and software that will let you connect your IBM PC compatible computer to a shortwave, or other radio, so that you can receive these images.

Whether you are ready to study global warming, track storms, or just see if it is worth packing off to your favorite dark sky site, SSC's weather facsimile products are for you.

At $129 our entry level system includes the radio to computer interface, software, manual and tutorial audio cassette. Software and interfaces for direct satellite reception start at $250. All packages include our image processing software with advanced features like false colorization, time lapse frame looping, zoom, scroll pan and many other features.

Software Systems Consulting
615 S. El Camino Real, San Clemente, CA 92672
Tel: (714) 498-5784 • Fax: (714) 498-0568


WONDERS THAT WITNESS VOL. 1
SHOW ME GOD
What the Message from Space Is Telling Us About God
How It Shocked Einstein, and How You Too Can Get a Bang Out of the Universe
Fred Heeren
How This Century's Greatest Discoveries Point Skeptics to the God of the Bible

Evidence for God?

THE BOOK:

Show Me God is the first book to bring together the great cosmologists of our time to talk about their discoveries—and the implications for God.

In exclusive interviews, Stephen Hawking, George Smoot, Alan Guth, Arno Penzias and others speak of how their discoveries affect life's big questions: creation, the fine-tuning of the universe, why we're here, and the nature of God.

Brings the latest space results down to earth—a story well told.
—John Mather, COBE satellite chief scientist.

Hardcover • 336 pages • 67 photos • $19.99

NEW VIDEO: ***Evidence for God?***
—Fred Heeren Interviews Today's Top Space Scientists

Follow this science writer in his quest to find answers to life's big questions. Hear the discoverers of cosmic seeds and primeval galaxies explain what they've found in their own words. Fred Heeren also takes his questions to people on the street, showing how many commonly held assumptions about an "accidental" universe now contradict plain facts. VHS 30 minutes

Regular price: $19.99 Introductory price: $16.88

NEW JOURNAL:

The new quarterly journal, *Cosmic Pursuit*, is just the thing for those who want to keep up with the latest on issues related to science and faith. The premiere issue features a debate on the subject of God's existence between Fred Heeren and atheistic physicist Bernard Leikind.

Regular Subscription price: $24.99 Introductory price: $19.99

Available at bookstores, or call today:

1-800-743-7700 Major credit cards accepted.

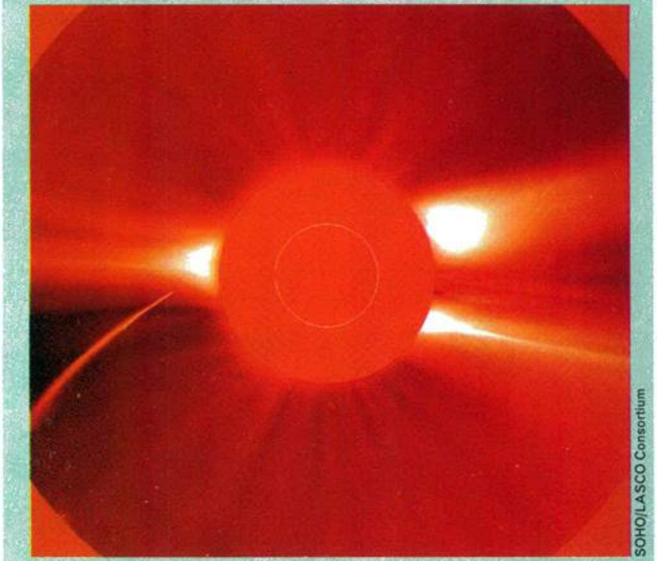
Day Star Publications, 326 S. Wille Avenue, Wheeling, IL 60090
Make checks out to "Day Star" and add $1.53 for shipping.

may be adrift among the 2,500 galaxies of the cluster, accounting for up to 10 percent of the cluster's mass.

"These stars are truly intergalactic," says Ferguson, "because they are so isolated that their motion is probably governed by the gravitational field of the cluster as a whole rather than the pull of any one galaxy." Observations with the newly installed Space Telescope Imaging Spectrograph and Near-Infrared and Multi-Object Spectrometer should help determine whether the stars wandered off from the outskirts of still-existing galaxies, are remnants of galaxies that were totally disrupted, or somehow formed in the darkness of intergalactic space.

Far from being an idle curiosity, the stars may one day help astronomers probe the distribution of dark matter in the cluster. The stars could also provide an independent way to measure the distance to the Virgo Cluster, a cornerstone for estimating the expansion rate and age of the universe.

SOLAR SCENE



SOHO/LASCO Consortium

SOHO VIEWS THE SUN A comet plunges toward its death in this view from the orbiting Solar and Heliospheric Observatory (SOHO) taken on the morning of December 23, 1996. Researchers discovered the comet, known as SOHO 6, with the Large Angle Spectrometric Coronagraph instrument, which blocks the intense brightness of the sun's visible disk to bring out faint details in the corona. The image spans 5.25 million miles (8.4 million km) and shows streamers emanating along the sun's equator, where the solar wind originates. One of seven sungrazing comets discovered with this instrument, SOHO 6 met its fiery demise later that same day.

PLANET FORMATION

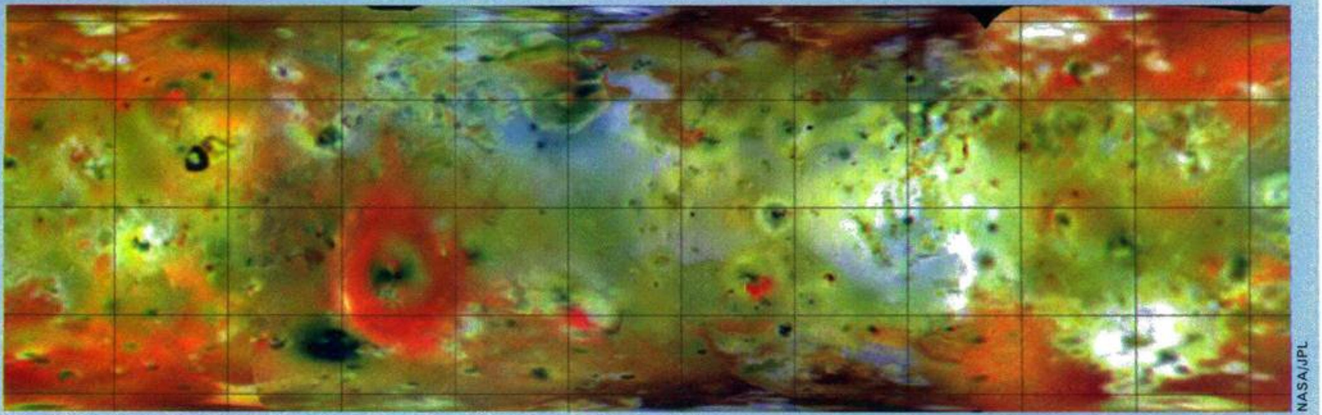
Dusty Disk Found around Binary Star

Could be first step toward a planetary system

▶ Can binary stars have planets? The answer appears to be a resounding "yes." Several of the recently discovered planets orbit one star within a binary pair. Now, for the first time, astronomers have imaged a dust disk surrounding a binary star, a disk in which planetary building blocks may have already formed.

The disk surrounds the binary star BD +31°643, about 1,000 light-years away

VOLCANIC IO



NASA/JPL

A GLOBAL VIEW OF IO Nearly all of Jupiter's volcanically active moon Io shows up in this false-color composite picture produced from images returned in 1996 by the Galileo spacecraft. Deposits of sulfur dioxide frost appear white and gray in this view, while other sulfurous materials presumably cause the yellow and brown shades. The bright red color, most noticeable as a prominent ring surrounding the volcano Pele, and the dark spots represent areas of recent volcanic activity.

The colors in the image come from observations taken through near-infrared, green, and violet filters (shown as red, green, and blue, respectively) by the Solid State Imaging system onboard Galileo. The distance from the spacecraft to the moon ranged from 300,000 to 1,390,000 miles (485,000 to 2,243,000 kilometers). Planetary scientists will compare the color map to maps of the moon's topography and surface temperature to better understand the volcanic and surface properties of Io.

There's No Place Like Deep Space

New Features!

ORION®

Deep Space Explorers™

Newly Modified For Enhanced Performance and Styling

ORION
10
DEEP SPACE EXPLORER
DSE

Standard accessories include a 25mm Explorer II eyepiece and a 5x finder scope

10" DSE
1140mm, f/4.5
$699

ORION
8
6
DEEP SPACE EXPLORER
DSE

8" DSE
1200mm, f/6
$469

6" DSE
1200mm, f/7.9
$359

Special Limited-Time Offer

FREE!

with DSE purchase

ORION
Where The Stars Are

Where The Stars Are™

Astronomy CD-ROM
For Windows 95/3.1x
An $89 Value!

Now with smooth rack-and-pinion focuser (1.25") for easier focusing.

Now with four-vane secondary mirror mount for more precise collimation.

Now with larger handle on the Dobsonian base for easier carrying.

Bonus Accessory Package!

ONLY $44.95

Order your Deep Space Explorer with Orion's Bonus Accessory Package instead of the standard accessories for just an additional $44.95—a terrific value! The Bonus Accessory Package includes:

- **Orion Explorer II™ 25mm, 17mm, and 10mm eyepieces** (reg. $104.85)
- **Orion EZ Finder™ Reflex Sight** (reg. $39.95)
- **Orion 5x Finder Scope** (reg. $24.95)
- **Orion DeepMap 600™ Star Chart, Paper Edition** (reg. $9.95)

ORION EZ Finder
ORION
DEEPMAP 600
Map by Wil Tirion

If purchased individually these items would cost $179.70!

Bonus Accessory Package available only at time of DSE purchase; not sold separately.

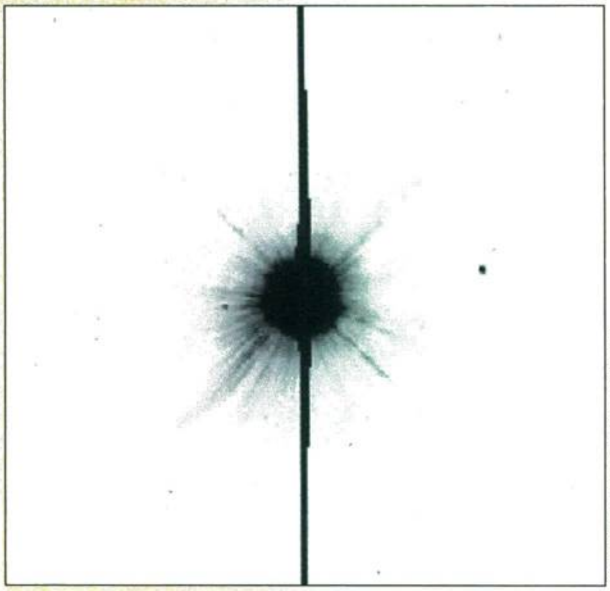
ORION
TELESCOPES & BINOCULARS

Available from finer optical instrument retailers. Also available from the exclusive mail-order dealer for Orion products:

Telescope & Binocular Center
Call Toll Free (800) 447-1001

Prices shown are suggested mail-order prices and may vary at independent retail stores. Shipping and handling charge additional: 6" $39, 8" $49, 10" $69.

HUBBLE SPACE TELESCOPE



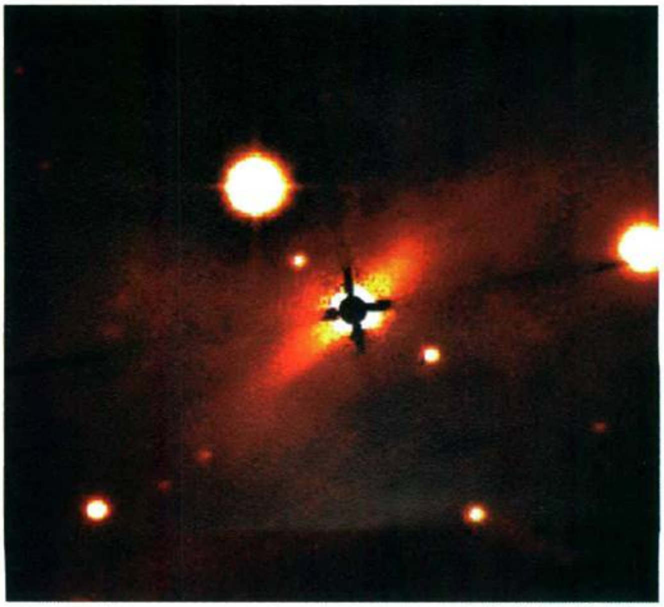
Ronald Gilliland (STScI), et al., and NASA

SOLVING THE PROCYON MYSTERY Using the amazing resolution of the Hubble Space Telescope, a team of astronomers led by Terry Girard of Yale University was able to solve a long-standing mystery surrounding the bright F5 star Procyon, located 11.4 light-years from Earth. Procyon has a white dwarf companion, seen as the dark spot to the right of the overexposed Procyon. The two stars orbit each other every 40 years. Based on previous observations from ground-based telescopes, astronomers had estimated Procyon's mass to be 1.75 solar masses. But according to stellar evolution models, a star of that mass should be brighter and hotter than Procyon actually is. By measuring the orbital separation to high accuracy, Hubble showed that Procyon's actual mass is only 1.465 solar masses. This value falls perfectly in line with theoretical predictions.

in Perseus. The system consists of two main sequence B-type stars, both of which are about 5 times more massive than the sun. The two stars are separated by at least 200 AU, five times Pluto's average distance from the sun. The disk is a colossal one-fifth of a light-year in diameter and contains more than enough material to form several Jupiter-mass planets.

The disk is the second known example of its type; the first was discovered around the star Beta Pictoris in 1983. Both disks contain little gas and both are at least one million years old. In contrast, disks seen in the Orion Nebula are much younger and contain mostly gas. According to the discoverers of the new disk, Paul Kalas of the Max Planck Institute for Astronomy in Germany and David Jewitt of the University of Hawaii, BD +31°643 and Beta Pictoris exhibit the "smoking gun" of planet formation. Dust particles in the disks must be constantly replenished by collisions between protoplanetary bodies; the central stars would otherwise blow the disks away in just a few thousand years.

"Our observations and interpretations remain to be tested by other astronomers," says Kalas. "But if they are confirmed, it indicates that binaries are capable of forming and supporting a system of planetesimals. If we can show that binaries are indeed capable of supporting planet formation, then the number of estimated planets in our galaxy would be much greater."



Paul Kalas and David Jewitt

Paul Kalas and David Jewitt used the University of Hawaii's 2.2-meter telescope on Mauna Kea to image the binary star BD +31°643. The two astronomers employed a coronagraph to block the light of the two stars. The resulting image shows a dusty disk around the binary, a disk which might contain the building blocks of planets.

EXTENDED MISSION

Galileo to Keep Flying

Several flybys of Europa and Io planned

▶ NASA has approved an extension of the Galileo project when the spacecraft completes its primary mission in December 1997. Named Galileo Europa, this new two-year program funds Galileo for an additional 14 orbits of Jupiter, the first 8 making close encounters with Europa. An additional 1,000 photos will be taken, some showing features smaller than 200 feet. "We're spending the lion's size of the extended mission on Europa," says Jan Ludwinski of the Jet Propulsion Laboratory. "It would be wonderful if we found proof of liquid water there right this minute."

Galileo will then make four flybys of Callisto, lowering the craft's orbit and sending it repeatedly through the ion plasma torus that surrounds Io. Should Galileo survive the

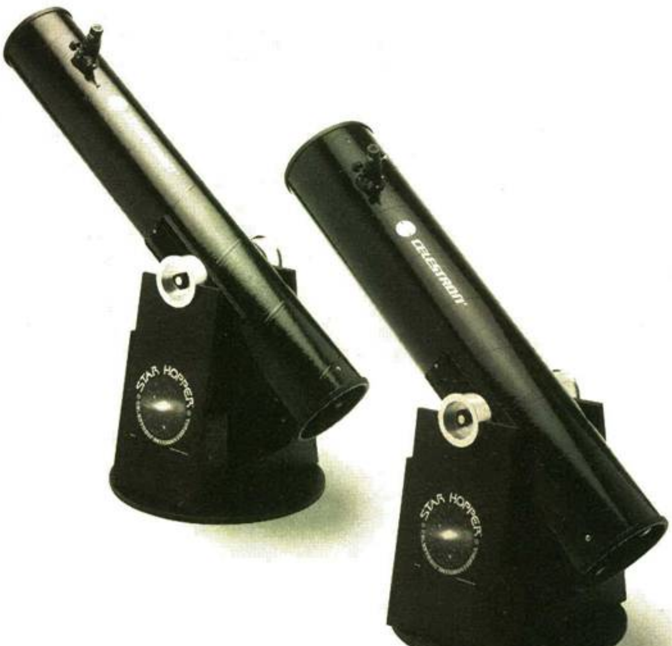
CELESTRON® DOBS

STAR HOPPER™ 6" *and* 8"

NEW

The **Star Hopper**™ *Dobsonians are designed for beginners yet they include many advanced features that even experienced observers will appreciate that are not available on any competitive models.*

- **6" f/8 and 8" f/6 models.**
- The **Dovetail Balance System** featured on the **Star Hopper**™ provides a smooth low friction altitude bearing that can be quickly and easily balanced when using optional accessories such as finderscopes or heavier oculars. Without proper balance, fine aiming adjustments are difficult, such as centering an object in a high power eyepiece. **Celestron** is the only company to offer an adjustable counter balance system standard on its Dobsonian telescopes.
- The **Star Hopper**™ **6"** and **8"** primary mirrors are housed in 8" and 10" ID tubes respectfully. The oversized flat black anti-reflective painted tubes reduce light scatter and tube currents. These features increase image contrast and improve "seeing" when viewing planets and the Moon.
- The **V-Spectrum LTM Optical System** features a unique molded **Pyrex** mirror, **multi-coated** for increased reflectivity, that provides superior optical and thermal qualities and it is mounted on the **Pinnacle** mirror cell.
- The **V-Spectrum LTM (Low Thermal Mass)** mirror is manufactured and figured to reach the optimal marriage of weight to optical surface resulting in a mirror with 40% less mass than traditional mirrors. Reducing the mass lowers the "cool down" period required to bring the mirror to ambient temperature and leaves more time for observing. An optional fan can be placed behind the **Pinnacle** mirror cell to create a laminar flow of air over the **V-Spectrum LTM** primary mirror to optimize the mirror for planetary and high power observations..
- Our unique and heavy duty, single vane secondary mirror bracket creates minimal obstruction allowing more light to reach the primary.
- Our unique mount features a 10° angled rocker box which increases stability.
- Ultra smooth motion in both axes for easy finding and observing of objects.
- Included standard are a smooth operating 1¼" Rack and Pinion Focuser, a handy Collimation Tool, 25mm SMA (52°) Eyepiece – 1¼" (49x).
- Numerous accessories are available including various pointing aids — from a traditional 6x30 Finderscope, to a state-of-the-art zero power red dot pointing device — the **Star Pointer**, to the Astro Master® models to computerize your telescope.
- Manufactured at Celestron's factory in the U.S.A.
- All of the above features and yet an economical price.



CELESTRON EQUATORIAL NEWTONIAN TELESCOPES

C4.5 Its 900mm focal length (f/7.9) optical system is housed in an aluminum tube. The mirrors (primary and secondary) have multi-coatings for improved contrast and resolution. The premium optics are manufactured in Japan to rigid **Celestron** specifications.

The **C4.5** uses the Polaris mount which is a very rigid German equatorial type. The very rigid wood tripod is fixed in height for added stability and is supplied with an accessory tray. A quote from *Astronomy Magazine*, "the **C4.5** stands out from the pack by having by far the best mount. Its Polaris mount is wonderful. Solid. Smooth. And with a damping time of two seconds. It was a joy using this telescope." "This is a first-rate telescope that outclasses the competition in the popular 4½" class of Newtonians." Further they said, "the C4.5 star images were classic textbook Airy disks".

Standard accessories include a 26mm multi-coated Plössl Eyepiece – 1¼" (35x), high quality 6x30 Finderscope and a 1¼" Focuser.

Firstscope 114 Its 910mm focal length (f/8) optical system is housed in an aluminum tube. This high quality yet economical telescope is made in a modern, high quality telescope factory in China to **Celestron's** specifications.

The equatorial mount is stable and includes setting circles in both axes as well as slow-motion cables in both axes for easy tracking. The wood tripod is adjustable in height and includes an accessory tray.

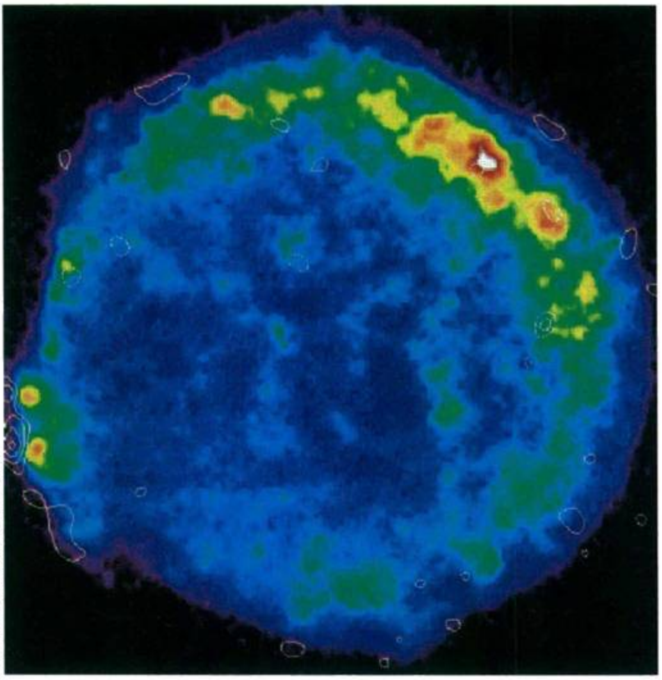
Standard accessories include a 5x24 Finderscope, 1¼" Focuser (with a .96" adapter), 20mm H–.96" Eyepiece (46x), 4mm SR–.96" Eyepiece (228x), 2x Barlow Lens –.96"

A **Firstscope 114 Deluxe** model is available which replaces all .96" accessories with two high quality 1¼" eyepieces – 25mm SMA (36x) and 10mm SMA (91x). The 1¼" accessories give you sharper views, a wider field of view and better eye relief.

CELESTRON®

For more detailed information on these telescopes, contact a Celestron dealer or Celestron.

Celestron International • 2835 Columbia Street, Torrance, CA 90503 • (310) 328-9560 • FAX (310) 212-5835



John P. Hughes (Rutgers University)

Glowing brightly in x rays, Tycho's supernova remnant shines from across 8,000 light-years of our galaxy. In this false-color image taken by ROSAT, most of the bright regions mark clumps of material ejected from the star that exploded 425 years ago. Contours represent features that have moved significantly during the past five years, and include two high-velocity knots seen on the left side of the image.

intense radiation in the torus, it will then complete its mission with two extremely close encounters of Io, diving to within 187 miles of the volcano-ravaged satellite in the fall of 1999.

— ROBERT ZIMMERMAN

TYCHO'S "NEW STAR"

Close-up of Supernova Remnant

Expansion slowing down after 400 years

▶ On the night of November 11, 1572, Tycho Brahe observed a bright "new star" in the constellation Cassiopeia, shining as brilliantly as the brightest planet, Venus. What he saw, and continued to observe for 18 months as it slowly faded, were the death throes of an exploding star — a supernova. Now astronomers have measured the expansion rate of the 425-year-old supernova remnant, providing new insights into how supernovae occur and how their remnants evolve.

Modern observations of the remnant show a diffuse ring of emission, made mostly of material ejected by the supernova, that spans approximately 20 light-years. For the remnant to reach that size in 425 years implies that it must be expanding at a speed, averaged over its lifetime, of 4,500 miles per second.

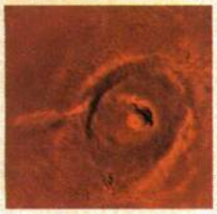
But what of its current speed? Using observations taken over a five-year span

A Cometary Asteroid

Scientists from the Jet Propulsion Laboratory have discovered what they think is the first known asteroid to have come from the Oort cloud. Known as 1996PW, it measures 5 to 10 miles across and has a very comet-like orbit, taking about 5,800 years to go once around the sun and reaching a maximum distance of more than 60 billion miles. Showing no evidence of being an extinct comet or an asteroid recently ejected from the inner solar system, 1996PW is probably one of about 8 billion such asteroids thought to exist in the Oort cloud that, like comets, sometimes plunge in toward the sun.

The Changing Martian Topography

Olympus Mons (elevation 75,740 feet [23,085 meters]) has now been replaced by its sister volcano on the Tharsis Bulge, Ascraeus Mons (elevation 78,555 feet [23,944 meters]), as the highest peak on Mars. Wolfgang Zeitler and J. Oberst of the Institute of Planetary Exploration in Berlin, Germany, carefully analyzed Viking data to digitally remap the planet's shape and hence determined its highest and lowest points relative to the center. They also note that the lowest point on the martian surface is not the Hellas Basin as previously thought but the albedo feature named Margaritifer Sinus.



USGS

Ascraeus Mons now ranks as the tallest mountain on Mars.

Ice on the Moon

It appears that if any permanently shadowed regions on the moon exist where ice could survive, their locations are far more constrained than first thought. According to David Smith and Maria Zuber of the Goddard Space Flight Center, permanent shadows could exist only in craters smaller than 20 miles across and located within 5° latitude of the lunar poles. At lower latitudes, any ice left by comets eons ago would have evaporated as the moon's axis precessed over time, changing the moon's orientation.

Big Mirror Looks Good

Scientists got their initial view in early April of the first of two 8.4-meter mirrors earmarked for the Large Binocular Telescope. "It's a keeper," says Roger Angel of the Steward Observatory Mirror Lab. "The glass appears well-formed into a sound honeycomb structure with almost no bubbles." Although a little glass leaked out during the casting, leaving about 10% of the mirror's surface slightly thinner than desired, the scientists will melt on additional glass before the mirror is polished.

Rivers CAMERA SHOP

"Call for our informative catalog"

AUTHORIZED MEADE® APD MAIL-ORDER DEALER

Meade LX200's
on
display

8" LX200
$2795
+ 105 P & S

Meade
4500
$399.95
+ 20 P & S

Most Meade Products In Stock/On Display!

- Meade Starfinder Dobsonians & Equatorials
- Meade LX50's
- 230, 390, 395, 4500's
- Meade Series 3000 and 4000 Eyepieces
- Most other Meade accessories in stock

Rivers CAMERA SHOP
454 Central Ave.
Dover, NH 03820
Phone: (800) 245-7963 • Fax (603) 742-5456
Hours: M-Th 8:30-6:00, Fri. 8:30-8:00, Sat. 8:30-5:30

Why Buy From Us?

NE's Largest Telescope Display

Mail-Order or In-Store. No Sales Tax!

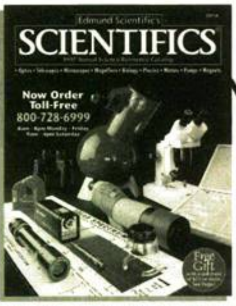
Used Scopes– Buy, Sell or Trade-In

Knowledgeable, Helpful, Friendly Staff

MEADE®

CELESTRON®

TeleVue®



WHERE SCIENCE COMES ALIVE

- ASTRONOMY
- MAGNIFIERS
- BINOCULARS
- MICROSCOPES
- OPTICS
- PHYSICS
- ROBOTS
- MOTORS
- MAGNETS
- BIOLOGY
- CHEMISTRY
- TELESCOPES

Explore a fascinating world of science in our new 112 page **'SCIENTIFICS'** catalog, featuring over 5500 scientific, educational and optical products.

FREE CATALOG
800-728-6999
or E-mail: A971C921@edsci.com

Visit our new web site at: www.edsci.com

Edmund Scientific
CONSUMER SCIENCE DIVISION
Dept. A971, C921 Edscorp Bldg., Barrington, NJ 08007
Phone: 609-547-8880 ■ Fax: 609-547-3292

The stars are yours *now* . . .

ST7 image of Andromeda, 300mm lens

with a CCD from *astronomics*.

Not just the stars . . . but galaxies, nebulas, the planets, the Moon – all can be captured on Meade, SBIG, and Celestron CCDs available *from stock* at ***astronomics***.

Celestron: We stock the **Pixcel 255** guider/imager, made for Celestron by SBIG. We also stock the Celestron **Fastar** Schmidt-Cassegrain, a unique 8" telescope that can be used at *f/1.95*, f/6.3, f/10, and f/20 for CCD imaging.

Meade: We stock all Meade CCD products – the **201XT** stand-alone guider; the new **208XT** and **216XT** guider/imagers; the **416XT** and **1616XT** imagers with separate 201XT and guider body; **Epoch 2000** sky charting and image processing software.

Optec: We stock Optec's **MAXfield** telecompressors that turn an f/10 SCT into an f/3.3 speed demon for imaging with Celestron, Meade, and SBIG CCD cameras.

SBIG: We stock all SBIG cameras – the **ST-4** guider/imager; the **ST-6A** that's been one of the best-known cameras in research imaging, spectroscopy, and photometry for years; plus the unique **ST-7** and **ST-8** large format *self-guiding* imagers.

Software Bisque: We stock **CCDSoft** (formerly SkyPro) color image processing software; the **FOSTER CCD** imaging tutorial on CD-ROM; plus all versions of **TheSky**.

Write us, call us, or E-mail us at the addresses below for our free catalog 97C with pricing and more information on Celestron, Meade, and SBIG CCD imagers and autoguiders; plus information and prices on Optec and Software Bisque products and the hundreds of other astronomical products we stock.

astronomics
2401 Tee Circle, Suites 105/106, Norman, OK 73069
Toll-Free Order Line: **(800) 422-7876** 24-Hour FAX: **(405) 447-3337**
10 AM to 5 PM CST, Mon. thru Fri. MC, Visa, Discover, Amex.
Compuserve: 102603,3054 AOL: okastro@aol.com U. S. sales only.

TUTHILL, YOUR ASTRONOMICAL FRIEND SAYS

Start now to watch and photograph Sun Spots as they grow toward the next Solar Maximum with our SOLAR SKREEN® Sun Filter on your finder, binoculars or telescope.

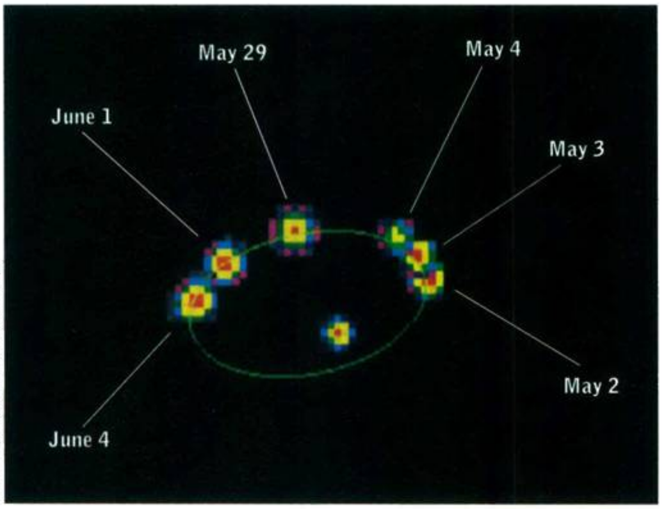
SOLAR SKREEN® FILTERS give sharper images of even the smallest Sun Spots than window glass solar filters. Send a large (9x12") SASE envelope (4 stamps) for a FREE sample of SOLAR SKREEN®.

SOLAR SKREEN®

Roger W. Tuthill, 11 Tanglewood Ln., BX
Mountainside, NJ 07092

with the ROSAT x-ray satellite, a team of astronomers led by John Hughes of Rutgers University has measured the current rate of expansion at only 3,200 miles per second. The remnant is slowing down as the supernova ejecta interacts with pre-existing interstellar gas, and it implies that the ejecta's motion still dominates the remnant's evolution. Although that conflicts with optical and radio observations that seemed to show an older evolutionary state, it is consistent with the bright emission lines seen in the x-ray spectrum.

The ROSAT images also revealed two small, roughly circular knots moving at a whopping 5,300 miles per second. These knots show striking differences, with the northern one rich in silicon and sulfur and the southern one rich in iron. This implies that the knots formed in entirely different locations — the iron-rich knot in the center of the exploded star and the other one farther out. The existence of such high-velocity knots poses a challenge to theorists, but Hughes suggests that supernovae may be less homogeneous and symmetric than many astronomers had thought.



Arsen Hajian (U. S. Naval Observatory)

Using the Navy Prototype Optical Interferometer, astronomers have resolved the two stars that make up Zeta^1 Ursae Majoris. The stars, which orbit each other in just 20 days, would look like a single point of light in any other telescope.

INTERFEROMETRY

High-Resolution Optical Images

▶ With a good solar filter, observers with typical backyard telescopes can view one of the more obvious features of the sun: that its limb appears darker than the center of its disk. Yet using the largest telescopes in the world, astronomers still hadn't seen this phenomenon on any other star. Until now.

The problem had been that from Earth all other stars appear as points of light — too small to reveal any detail. But astronomers from the U. S. Naval Observatory, the Naval Research Laboratory, and Universities Space Research Association built the Navy Prototype Optical Interferometer, which uses several 14-inch telescopes to achieve the resolution of a single telescope as big as the separations between the scopes. With it, they detected limb darkening on two red giant stars, Alpha Arietis (Hamal) and Alpha Cassiopeiae (Schedar).

Both stars are about 0.005 arcsecond in diameter, the size of a billboard on the moon and about 100 times smaller than any ground-based scope can resolve. When complete, the interferometer will resolve objects as small as 0.0001 arcsecond, the size of an astronaut's footprint on the moon. Arsen Hajian of the U. S. Naval Observatory says that "if your eyes had this resolving capability, you would be able to see the atoms composing your hand at arm's length." The astronomers hope one day to image stellar surfaces with the interferometer.

ASTRONOMY FRONTIERS

Quasars Surrounded by Normal Galaxies

Astronomers confirm their earlier expectations

▶ Observations with the two largest optical telescopes in the world confirm that many quasars lie at the centers of normal galaxies and hint that collisions between galaxies may fuel the enormous energy outputs of at least some quasars, the most luminous objects known in the universe.

Astronomers from the University of California Observatories/Lick Observatory used the twin 10-meter Keck I and Keck II Telescopes in Hawaii to take spectra of the nebulous blobs surrounding 10 bright and reasonably nearby quasars. The spectra, which reveal both the compositions and distances of luminous objects, showed the blobs to be aggregates of normal stars lying at the same distances as the quasars. Although most astronomers thought quasars reside in normal galaxies, the Keck spectra are the first to confirm it.

"The evidence is extraordinarily strong that quasars live in host galaxies, just as we expected," says team leader Joseph Miller. "This is consistent with the hypothesis that quasars are natural features of massive galaxies and that they are direct consequences of how galaxies evolve, not strange aberrations or freaks of nature."

The astronomers also took spectra of a few companion blobs lying near the host galaxies and found that they were large populations of stars lying at the same distances as the hosts. According to Miller, these stars probably represent the cores of galaxies being ripped apart as they collide with the host galaxies. Such collisions could be throwing fuel onto the supermassive black holes that presumably power the quasars, causing them to shine with even greater vigor. ▣

VISIT OUR WEBSITE AT: http://www.focuscamera.com

ORDERS ONLY 800-221-0828

focus Telescopes

CAMERA & VIDEO

INFORMATION HOTLINE: 718-437-8810

FAX: 800-TO-FOCUS

MEADE'S ONLY AUTHORIZED EAST COAST APD MAIL-ORDER DEALER

E-MAIL US VIA COMPUSERVE: 75457,1403

E-MAIL US VIA COMPUSERVE: 75457,1403

MEADE ADVANCED PRODUCTS

FREE GIFT WITH EVERY ORDER!

SCHMIDT-CASSEGRAINS

LX-200 w/Heavy Duty Fork Mount & Tripod

8"	2795	12"	CALL
10"	CALL	16"	CALL

NEW! LX-200 Schmidt-Camera f/2.2	CALL

MAKSUTOV-CASSEGRAIN

LX-50 7" f/15	1795
LX-200 7" f/15	3295

LX-50 w/Std Equat Wedge

LX-50 8" f/10	1395
LX-50 10" f/10	1695
LX-50 10" f/10 w/Super Wedge	1895
NEW! LX-10 8" w/Hand Controller	995

MAGELLAN II

#2018 f/Equatorial 6", 8" & 10"	495
#2019 w/SMC Multicoatings 595 #2024 f/LX-50	495
MAGELLAN I #2014 f/LX-10	349
MAGELLAN I #2010, #2011 & #2012 f/All Dobsonians & Equatorials	295

STARFINDERS

* w/2" Focuser	EQUA. w/DC Drive *	DOBS.
6" f/8	649.95	319
8" f/6	749.95	419
10" f/4.5	879.95	599
12.5" f/4.5	--	895
16" f/4.5	2695	1195

TELRAD $36.49

SATURNS***		INFINITY
60 AZ	60 EQ	114 EQ
$95	$139	$209

*** *w/Totally New Mount & Optional #533 Motor Drive & FREE! Space Explorer Software, A $79 Value!*

ED APOCHROMATIC REFRACTORS

102 ED 4" f/9	CALL	178 ED 7" f/9	5995
127 ED 5" f/9	CALL	1664 Drive	349
152 ED 6" f/9	CALL	1697 Drive	689
227 60mm Alt **	CALL	290 60mm Equa **	119
223 60mm Alt **	79	390 90mm Alt	CALL
230 60mm Alt	99	395 90mm Equa	CALL
285 60mm Equa	CALL	4500 Newtonian	CALL

** INCLUDES *FREE!* STAR LOCATOR SOFTWARE

PICTOR SERIES CCD IMAGES

201-XT .395 208-XT .495 216-XT	695
416-XT w/$800 Upgrade	1695
1616-XT w/$800 Upgrade	5495
616 Color Filter System f/416-XT & 1616-XT	695
616A Color Filter System f/216-XT	695
520 Electronic Relay .99 CCD Off-Axis Guider	115
541 AC Adapter f/201, 208, 216 .37 f/416, 1616	99

Epoch 2000sk Sky Software

3.5" Disks .149 CD-ROM	179
Epoch 2000ip 3.5" Disks	199
LX-200 Interface Cable f/SK	25

TELESCOPE $PECIAL$

2080A "Perfect for the Beginner"			1078
2080B w/SMC Multicoatings			1178
Tipod & Wedge	*IN STOCK!*		1349
10"/12" Super Wedge	*IN STOCK!*		395
MTS SN-8	*IN STOCK!*	MTS-SN6	*IN STOCK!*
2045S 102mm	449	97-E2	*IN STOCK!*
Case for 2045D	74.95	Case for 2045S	47.95
Accessory Case #50			58.95

SUPER SPECIALS

PREMIER 2080 LX-6 8" f/6.3 w/Smart Drive	1999
PREMIER 2080 LX-6 8" f/10 w/Smart Drive	1999

2080 LX-6 Comes Complete w/Wedge, Tripod, LX-6 Hand Box, Electric DEC Motor, 9x60 RA Illum Ret. w/QR, #929 2" Diagonal, 26mm Plossl & 12.4 Plossl

C.A.T. 9000 RS f/LX-2, LX-3, LX-5, LX-6	999
Dig. Setting Circles 9060 f/8" 2080 LX-2/3/5	360
Dig. Setting Circles 9061 f/10" 2120 LX-2/3/5	360
Dig. Readout Sys. 9070 f/10" 2120 LX-2/3/5	360
#46 Dual Axis Drive Corr. f/2080, 2120	378

WE CARRY THE FULL LINE OF SERIES 4000 SUPER PLOSSLS, SUPER WIDE ANGLE, ULTRA WIDE ANGLE, ILLUMINATED RETICLE PLOSSL & SERRIES 3000 PLOSSL. ALL AT CURRENT MEADE PRICING!

PHOTO-VISUAL COLOR FILTERS 1.25"	14.95
Moon Filter #ND96	19.95
Set #1 4-Filters; #12, 23A, 58, 80A	49.95
Set #2 4-Filters; #11, 25A, 47, 82A	49.95
Set #2 4-Filters; #8, 21, 38A, 56	49.95

MEADE ACCESSORIES

Tripod f/LX-50	295	10"/12" Super Wedge	395
8" Wedge	128.95	10" Wedge	179
6.3 Focal Reducer	129	Off Axis Guider	80
Astrosearch 2000	99	Tripod f/LX-10	195
1205 Electric Focuser	156	**607** 25' Cig. Adapter	24.95
62 T-Adapter f/SCT	27	**927** 45° Erect .965"	43
928 Erect Diag. 1.25"	43	**929** 2" Diag Mirror	99
931 45° Hybrid Erect	43	Dew Shield 10"	110
47M Dual Axis Drive	Call	**#43** Drive Corrector	125
55 Manual Dec Control	80	**1206** Focuser	142
Vinyl Dust Cover f/SF EQ & DOB 6", 8", 10"			29.95

BARLOW LENSES

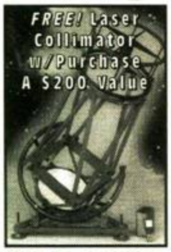
#122	42.95	#126	42.95	#127	53.95
#140 2x APO 3 Element					71.95

Customer Quote Of The Month

"Thank you for your help in choosin a Celestron telescope. It has arrived safely and seems to be working well. Just waiting for the sky to clear..."

Thank You Very Much, Ben

The JC524 by L-5 Systems



FREE! Laser Collimator w/Purchase A $200 Value

$14,900

Take The Next Step. Reaching For The Stars Is Within Your Grasp!

- **24" f/3.8 Diffraction Limit**
- **High Speed Go To Capability**
- **NGC, IGC, Messier Data Base**
- **LCD Auto Guider, Displays Images On LCD Screen, Over Hand Control (Optional)**

(Shipping & Crating Additional)

Center Leg f/High Altidudes (46°-66°)

NEW! ETX

ASTRO SCOPE • MAKSUTOV-CASSEGRAIN

with battery-powered motor drive, table tripod & 26mm Plossl $595

CELESTRON

ALL CELESTRON TELESCOPES IN STOCK!

NEW!
114 PREMIUM WITH ALL METAL TRIPOD IN STOCK

FIRSTSCOPES

60 EQ DLX	$159
80 EQ	$299
114 DLX	$289

SCHMIDT-CASSEGRAINS

CG-9 1/4 w/*Free* 2x Barlow!	$2499
CG-11 *SPECIAL!*	$3699
CG-14 (Special Order)	CALL
Ultima 11 PEC	$2999
Ultima 9 1/4 *w/Free* 2x Barlow!	$2399
C-8 Plus	$939
C-5 w/*FREE!* Celestron Tripod	$949
C-5 Plus	CALL
C 4.5 w/Wood Tripod	CALL
GPC-102	$1299
Premium 80	$599

NEW! ULTIMA 8 2000

w/Got To System & Hard Carry Case

$2699

Subject to Availability

CELESTRON/SBIG

NEW! PIXCEL 255 CCD CAMERA

$1499.00

COLOR FILTER WHEEL F/255

$349.00

GREAT COMET VIEWER C90 w/Photography Kit

Includes: 8x20 Erect Image Finder Scope, Photo Tripod Adapter, Lens Caps, DELUXE FOAM FITTED CASE, & T-Mount f/PK, FD, MD, MC, AIS, OM, EOS, MAX *

$349.95

* Other Mounts Avail. Please Inquire. Model #81018

CELESTRON TELESCOPE ACCESSORIES

Hand Controller f/Celestar 8, 8 Comp	CALL
Counter Weight Bar Assembly 8"	78.95
Counter Weight Bar Assembly 11"	84.95
Advanced Astro Master	
Digital Setting Circles f/C5	574.50
f/Fork Mounted C8	569.50
f/GP Mounts/G11	619.50
Finderscope 7x50 w/Illum. & Bracket	159.95
Focus Motor f/PEC (#94142)	129.95
Micro Guide Eyepiece	157.95
Motor Drive f/GP/SP	319.95
Piggyback Mount 8"	34.95
Polar Axis Finder f/G9, G11	139.95
Reducer Corrector f/6.3	112.50
Radial Guider f/C5, C8, C11, C14	114.95
Vibration Suppression Pads	39.95
Tripod, Heavy Duty f/5", 8", 11"	288.95
Tripod, Lightweight Field 5"/8" (#93591)	249.95
Tripod, Photo Altazimuth (#91533)	339.50
DEC Motor f/C8+, U8 (#93549)	CALL
Lens Shade C5 (#94011)	49.95
Lens Shade (#94107)	26.95
LPR Filters .CALL LV Oculars	CALL
Deluxe Carrying Case (#302069)	199.95
Diagonal Hybrid (#94106)	29.95
T-Adapter f/Refractor/Newtonian (#93634)	44.95
Deluxe Tele-Extender (#93634)	47.95
Ultima Barlow Lens ((#93506)	74.95
Barlow Lens 2x 1.25"	62.95
Shorty Barlow Lens (#93507)	44.95

EYEPIECES

LV 2.5, 4, 5, 6, 9, 10, 15mm 1.25"	CALL
PLOSSL 6.3, 7.5, 10, 12.5, 17, 26, 32, 40mm 1.25"	CALL
ULTIMA 5, 7.5, 12.5, 18, 24, 30, 35, 42mm 1.25"	CALL

FILTERS

Eyepiece Filters - 1.25" - !1A, 8, 12, 15, 21, 23A, 38A, 47, 56, 58, 80A, 82A, 96ND-50%T, 96ND-25%T, 96ND-13%T, Polarizing	CALL

STAR HOPPER DOBSONIAN

6" f/8 ..$389 8" f/6 ..$479

BUY A STAR HOPPER DOBSONIAN & RECEIVE *FREE!* 244x MAGNIFICATION KIT

(Kit Includes: Celestron SMA 10mm 1.25" & 2x Barlow 1.25" #93507)

CELESTAR 8 **	$999
NEW! CELESTAR 8 DELUXE	$1699
CELESTAR 8 COMPUTERIZED*	$1499

* *INTRODUCING!* "THE SKY" ASTRONOMY SOFTWARE CD. FREE! W/PURCHASE

** FREE HAND CONTROLLER

JMI Jim's Mobile Inc.

NEXT GENERATION COMPUTERS

NGC-microMAX Computer only	219
NGC-MAX Computer Only	499
NGC-miniMAX Computer only, multi-lingual	349

MOTOFOCUS

Celestron C-8, Meade 2080, 2120, LX-3, Meade ED Apochromatic, Meade Starfinder, Meade Newtonian, Televue Refractors	99
Meade LX-200, LX-5, LX-6	89

NGF FOCUSERS

NGF-S f/Schmidt-Cassegrains (Incl. Motofocus)	249

WHEELY BARS

Meade Field/Celestron Ultima - All 2080/2120 fork mounts (Except MTS) through LX-200, Starfinder 6/8/10, LXD-600/650, Celestron Ultima-8, Classic 8, C-8+/Super C-8 (with adjustable Tripod)	105
Same as above with leveling	139

MOTODEC

Celestron C-8	74
Celestron Polaris/Super Polaris	99
Meade 2080, 2120, LX-2, LX-3, LX-5, LX-6, MTS	84

THOUSAND OAKS OPTICAL
PRECISION GLASS SOLAR FILTERS MOUNTED TYPE 2 PLUS

TeleVue

"Tops In The Field"

NEW BINO VUE IN STOCK!

WE CARRY THE COMPLETE LINE OF NEW
PANOPTIC Task Sharp (68°)
NAGLER Spacewalk Experience (82°)
PLOSSL (50°) • WIDEFIELD (65°) • BARLOW

Pronto™

70mm w/2" Diagonal & 26mm Plossl	*ALL*
70mm w/1.25", 45° Erect Prism & 26mm Plossl	*PRONTOS*
70mm w/1.25" Mirror Diagonal & 26mm Plossl	*IN STOCK!*

Ranger

70mm w/Ivory Tube, 90° Diagonal & 20mm Plossl	549
70mm w/Ivory Tube, 45° Erect Prism & 20mm Plossl	539
NEW! **Photographic Field Flattener f/Ranger or Pronto**	89

GENESIS-SDF KIT

Sky Tour Observing System	CALL

BINOCULARS

CELESTRON

8x42 WP Regal	CALL	10x50 WP Regal	CALL

20x80 *w/Tripod Adapter & Case* . . $348.95

7x42 Ultima	179	8x56 Ultima	269
7x50 Ultima	239	9x63 Ultima	329
10x42 WA Ultima	199	10x50 Pro	CALL
How To Choose Binoculars			6.95

BAUSCH & LOMB BUSHNELL

7x36 Elite	470	8x42 Elite	CALL
10x42 Elite	CALL	10x40 Custom	299
7x42 Discoverer	329	10x42 Discoverer	359

SPOTTING SCOPES

Discoverer 15x60			169.95
Spacemaster	149.95	Kit	247.95
Spacemaster Armored	163.95	Kit	259.95
Spacemaster Black Armored Kit			248.95
Discoverer 15-45x Zoom			169.95

All Kits Include: 15-45x Eyepiece & Case or Pouch

SWIFT

11x80 OBSERVER	15x60 VANGUARD
$339.00	$189.00

Nikon SPORT OPTICS

"You'll Never See Things Quite The Same Again!"

SERIES E		CRITERION SERIES	
7x35 **274.95** 8x30	**299.95**	10x70 Astrolux	1048.95
10x35	323.95	7x50 Prostar	719.95
10x42 Superior	598.95	10x40 Execulite II	414.95

SPOTTING SCOPES

Fieldscope 60 ED II	565	60 ED II Angled	630
Fieldscope 78mm ED	985	78mm ED Angled	1070

FUJINON

6x30 FMTR-SX .CALL 8x30 FMTR-SX	CALL
7x50 FMT-SX w/Case	CALL
7x50 FMTR-SX Rubber Armored	CALL
7x50 FMTRC-SX Armored w/Compass	CALL
10x50 FMT-SX w/Case	CALL
16x70 FMT-SX w/Case	CALL
7x42 DCF Slim Style Armored	CALL
Super 80 Scope w/Zoom & Case	CALL

SPALDING

20x80 Eagle View	329.95	30x80 Eagle View	374.95

SWAROVSKI OPTIK

AT-80 • AT-80 HD Angled • ST-80 • ST-80 HD Straight

Leica® ZEISS

Focus Camera Inc., 4419-21 13th Avenue, Brooklyn, N.Y. THESE ADVERTISED PRICES ARE VALID June 1 - June 31 1997. SUBJECT TO PRODUCT AVAILABILITY. ORDERS ONLY CALL 800-221-0828. INFORMATION & NY STATE CALL (718)437-8810. ORDER STATUS & CUSTOMER SERVICE CALL (718)437-8899. 24 HOUR FAX LINE (718)437-8811. Orders shipped promptly - Most major credit cards, money orders & personal checks accepted for payment. COD orders are accepted but may require a deposit, personal checks may require up to 14 days to clear. All orders are subject to verification & acceptance. Shipping, handling & insurance are additional, please call, write or fax for exact details. 14-day money-back guarantee (less shipping) provided merchandise is returned in new condition, unused as received with papers & packaging intact. We gladly accept and reply to written or faxed inquiries. This ad supersedes all previous ads. Focus Camera is not responsible for typographical errors. Hours: Mon.-Thur. 9-7, Fri. 9-2, Sun. 10-6.

FOR ORDERS — TOLL FREE: 800-569-4323
INFORMATION: 717-842-1500

POCONO
For All Your Astro

PRECISION SOLAR FILTERS

by THOUSAND OAKS OPTICAL
NEW SOLAR VIEW™

Manufactured exclusively for Solar View by Thousand Oaks Optical

- **Highest quality**
- **Sizes to fit all telescopes and binoculars**
- **17 years of quality manufacturing in solar filters**
- **Most popular sizes in stock for immediate delivery**
- **30 day unconditional money-back guarantee**
- **10 free solar eclipse viewers with purchase of any filter ($10 value)**

Revolutionary New Coating & Deposition Process

SOLAR II PLUS (Pat. Pend.) — Thousand Oaks Optical has developed an exclusive new coating and deposition process that enhances resolution, and dramatically increases the useful life of their solar filters which are now guaranteed for 15 years. This state-of-the-art technology is unsurpassed and has revolutionized the solar filter industry.

Recognized around the world for product quality and cutting-edge advances, Thousand Oaks Optical filters are the preferred choices of telescope retailers and used exclusively by NASA aboard the Space Shuttle. Other professional users include: ABC, CBS, NBC, CNN News, NOVA, The Discovery Channel, National Geographic, and most major universities and observatories. Thousand Oaks Optical is the largest manufacturer of solar filters. Tens of thousands are in use worldwide.

Seventeen years of specialized experience in solar filter research and development provides customers with SAFE, RELIABLE, HIGH-QUALITY filters at reasonable prices. Thousand Oaks Optical is the acknowledged leader in this field. Don't settle for an "IMITATION."

NOTICE: Beware of a person claiming that he was once affiliated with Thousand Oaks Optical, and that his solar filters offer an Indentical View. Thousand Oaks Optical hereby disavows responsibility for the safety and quality of filters sold by this former employee whose responsibilities were limited to cleaning and assembly.

Type A — Made with high quality hand-select glass and TRIPLE COATED with nickel, chrome and stainless steel. Originally developed by Thousand Oaks Optical in 1983. The most durable solar filter on the market for thirteen years. Second only to the new Type A Plus. These filters are available at reduced prices while supplies last. Guaranteed six years.

Type A Plus — Made with high quality hand-select glass and coated with Thousand Oaks Optical's exclusive Solar II Plus. Dramatically more resistant to wear due to excessive handling and fading that results from long-term exposure to ultraviolet radiation. Durability of these new filters is unmatched. Guaranteed 15 years.

Type A and Type A Plus are for unlimited visual use and general photographic use. Solar image is yellow-orange. Transmission is 1/1000th of 1% (ND-5). Complete instructions and solar photography guide included with each filter.

Type C PLUS — Lighter density (ND-4) for maintaining fast shutter speeds when using "slow" fine grain films. For photographic use only. Transmission is 1/100th of 1%. Guaranteed 15 years.

APERTURE	**TYPE A**	**TYPE A + or C +**
2.4"	38.00	52.00
3.1"	42.00	55.00
3.5"-4.5"	49.00	65.00
5.0"	62.00	85.00
6.0"-7.0"	67.00	92.00
8.0"-10.0"	92.00	112.00
11"	99.00	139.00
12"-13.1"	119.00	159.00
14"	139.00	179.00
BINOCULARS	**TYPE A**	
40-80MM	79.00 pr	99.00 pr

Unmounted filters for custom applications are $14.00 less than prices listed above.

PRICE GUARANTEE: If you find a lower price on any competitive brand of glass solar filter, simply note the brand and we'll match it.

ORDERING INFORMATION
Solar View filters are shipped free in continental U.S. Please specify telescope brand and/or outside diameter measurement of telescope tube.

DEALER INQUIRIES INVITED

Tele Vue "WHEN YOU WANT THE FINEST"

We stock the entire Tele Vue line for immediate shipment. - All items also on display and available for purchase and pick up at our showroom.

Special Sale Prices Now in Effect
Contact us: The Tele Vue Specialists

SPECIAL!!!
PRONTO w/2" DIAGONAL
Panoramic Mount and Quick Point Finder. **CALL**

Imagine a Walk in Space!

NAGLERS 82° Apparent Field of View

Patented Tele Vue Naglers offer the widest, sharpest views available. Why settle for a back seat view when you can experience a *spacewalk?*
Choose from 4.8, 7, 9, 12, 13, 16 and the amazing 20mm! Call us today for sharp prices and large selection!

Tack Sharp!

PANOPTICS 68°

Attack your
eyepiece —
considered
1¼" 22mm
weight, sma
focal length

— *New For 1997* —
19MM PANOPTIC!
Now Available

ewest
m are
class. The
nce, lighter
d with similar

Tele Vue's Best Eyepiece Value!

PLOSSLS 50 Apparent Field of View

Patented Tele Vue Plossl eyepieces started the trend toward higher-quality, high-performance eyepiece designs. And today, despite the many imitators available, they still deliver the sharpest views in their class. And buying Tele Vue Plossls is the smart way to stretch your astro dollar. Our stock selection includes 1¼", 8, 11, 15, 20, 25, 32, 40, 55 fl. Don't forget the 2" 55MM, which yields the widest true FOV available.

SKY TOUR
Package

Exciting Sale Priced Packages for Genesis and Gibraltar — contact us for exciting details which include Free Eyepieces, Solar Filter and More!!

PRONTO

70MM AP.F6.8, 480MM F.L. Available in 1¼" Image Erect, 1¼" Star Diagonal and 2" Star Diagonal models.
"The little scope — that could"

RANGER — IN STOCK

GENESIS SDF — FREE Eyepiece When you purchase this World Famous Telescope

NEW — 1.25 2x & 3x Barlows

TeleVue Bino Vue Has Arrived!! Contact Us For Details!!!

New TV-140-You asked for it and it's finally here-the magnificent new 140MM Refractor-the big brother to the Genesis SDF-Call us for exciting details on this custom scope or stop in and see it in person.

Pocono Mountain Optics is your Tele Vue headquarters! Give us a call today, and see why our selection, price and service are second to none!

The Kendrick Dew Remover System for all size scopes, finders and mirrors

Dew Controller	
(Works up to 4 Heaters)	**$64.00**
120 Volt Conversion Kit	**$59.00**
.965"/1.25" Eyepiece Dew Heater	**$30.00**
1.25"/2" Eyepiece Dew Heater	**$33.00**
2" Dew Heater	**$34.00**
3" Dew Heater	**$38.00**
4" Dew Heater	**$41.00**
5" Dew Heater	**$44.00**
5.5"/6.5" Dew Heater	**$45.00**
7"/8" Dew Heater	**$49.00**
9"/10"/11" Dew Heater	**$59.00**
12" Dew Heater	**$68.00**
14"/16" Dew Heater	**$77.00**
Telrad Heater	**$19.00**
1.83"/2.14" Secondary Heater	**$22.00**
2.60"/3.50" Secondary Heater	**$24.00**
4.00" and up Secondary Heater	**$25.00**

Flexible Dew Caps from Kendrick

ETX 90mm	$25
5"	$31
6"	$41
7/8"	$49
9.25"	$52
10"	$59
11"	$68
12"	$83
14"	$99

New Products Exclusively from Kendrick

Heater Unit for LX-200 Command Hand Control	$33
Heater Unit for Your Lap Top Computer	$119.00

THE SERIES II GERMAN EQUATORIAL MOUNT

Ideal for Small Telescopes, Spotting Scopes and Telephoto Lenses

Featuring:
- Quick Release Dovetail Instrument Platform with Balance Adjustment
- Dual Adjustable Counterweights
- Self-Contained DC Right-Ascension Drive
- Adjustable Drive Clutch
- Declination Axis Lock
- Attaches to ¼ or 3/8 Tripod Mount

Sale Priced
$295

PORTA PAC
Heavy Duty
12 AMP HR.
$86.95

Porta Pac 5 AMP HR. $65.00

New 17 Amp hr. $119.00

Tectron Collimators Improve Newtonian Images with the following:

Sight Tube	$29.	Above 3 w/Bklt.	$95.
Cheshire Eyep.	$38.	New "Revised" Booklet on Collimation	$ 8.
Auto-collimator	$31.		

For that Fast New Scope You're building or for upgrading your current scope —

New — The Modern Dobsonian Booklet . . . .$11.00 Photographic Focuser $159.00

POCONO MOUNTAIN OPTICS

ORDERS-TOLL FREE: 800-569-4323 till 10 P.M., 7 days a week
Information: 717-842-1500 till 10 P.M. NEW FAX NO. (24 hours) 717-842-8364

SHOWROOM HOURS 10 a.m.-5 p.m.
Monday thru Saturday
Sundays Noon-5 p.m.
Prices subject to change

E-MAIL us at pocmtnop@ptdprolog.net

MOUNTAIN OPTICS

nomical Needs from Beginners to Advanced

POCONO MOUNTAIN OPTICS is pleased to handle the following products to better serve you-
- **Virgo Binocular Mounts**
- **Optec Focal Reducers**
- **Rainbow Optics Star Spectroscope**
- **Homeyer Flip Mirrors**
- **Apogee Cameras**

OBSERVE IN COMFORT

with STAR-BOUND

VIEWING CHAIR

- Portable, Adjustable from 9″ to 32″
- Padded Seat
- Porcelain Black Powder Coated

$159.00 Dealer Inquiries Invited

BINOCULAR SPECIALS

Fujinon
FMT SERIES
Ideal for Astronomy

Contact us for the best pricing on the best binoculars for Astronomy — 6x30 FMTR-SX, 7X50 FMT-SX, 7X50 FMTRSX, 7X50 FMTRCSX The unbelievable 10X70 FMT-SX and the 16X70FMT SX.
7x50 and 10X70 have eye relief of 23MM
16X70 has eye relief of 12.4MM

Tripod Adapter Bracket	**$15.00**

Available for immediate shipment
We also carry and stock Zeiss, Swarovski, Swift, Nikon, Pentax, B&L, Steiner, Minolta and Kowa spotting scopes.

JIM'S MOBILE

We stock the entire JMI line — SPECIALS

Moto-Focus LX5/6/200	**$85.00**
Moto-Decs LX3/5/6	**$77.00**
Moto-Focus 2080/2120 Basic & LX3	**$89.00**

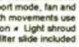
Moto-Focus and Moto-Decs for all scopes available. Contact us for special sale prices on NGC Mini Max, NGC Max, Micro Max.

New — NFG-2 Deluxe Focuser (used on NGTs) with or without motor focus.

SPECIAL - Eliminate Image Shift with NGF-S Focuser **NEW REDUCED PRICE** **$249.00**

A AstroSystems A

AstroBeam
LASER COLLIMATOR

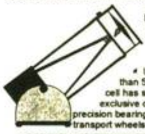


SPECIAL PRICE **The #1 Laser**
$155 ***Preferred by Amateur Astronomers***

Quick, easy, and accurate collimation for Newtonians • Exclusive 2 lens 5mW red diode laser module • Tested and aligned at 100 ft On/Off • 1.25″ / 2″ body accurate within .0005″ • Gold anodized alum 2 AA bateries • Powerful diagnostic tool • One Year Guarantee

TELEKIT NEW

DOBSONIAN TRUSS TUBE TELESCOPE KITS



From 10″ to 30″

Easy assembly and finishing with hand tools • A satisfying and rewarding experience • Precision cut Baltic Birch aircraft plywood components Easily customized and personalized • Upper cage stores in mirror box • Less than 5 min. set-up • Full floatation mirror cell has stainless sling, transport mode, fan and exclusive cover design • Both movements use precision bearings w/ adjustable friction • Light shroud transport wheels & P4 focuser w/ 2″filter slide included

'INTRODUCTORY SPECIAL-CALL'

BEATTIE INTENSCREEN-PLUS

Ultra bright focus screens for:

Olympus OM - 1, 2, 3, 4	**$62.00**
Nikon F, F2, F3	**$93.95**
Nikon FE, FE2, FM2, FA	**$62.00**

Announcing New Nebula Filters by Thousand Oaks

Type LP-1 Broad Band
Type LP-2 Narrow Band
Type LP-3 Oxygen
Type LP-4 Hydrogen
Avail. for 1.25″ & 2″ eyepieces.

ALL LUMICON FILTERS IN STOCK

Deep Sky, UHC/OX3/H-Beta 1.25″	**$99.50**

48MM and rear cell sizes stocked

We are a dealer for Tech 2000 Dob Drivers. We also handle Parks, Daystar T-Scanners and University Optics.

LOSMANDY GM8 Mount

Complete System Package

Dual Axis, PEC DRIVE, North-South operation. Three photo guide rates. Auto guider ready. Four tracking rates.

Adapter Plate. (Specify Telescope) 7 lb. counterweight. Weight capacity — 30 lbs.

$1449.00

Many optional accessories available.
Dealer Inquiries Invited

The GM-8 is perfectly suited for the following telescopes — Astro Physics 4″ Traveler, Astro Physics 5″ F-8, Celestron C-5, C-8, C-9.25 SCT, 25 SCT, Celestron 102 Refractor, Ceravolo HD-145, Meade 8″ and 10″ SCT, Meade 4″ and 5″ APO, Tele Vue Pronto and Genesis and new Meade 7″ Maksutov.

INTRODUCING
Losmandy Digital Setting Circles

- 9000 + objects includes Messier, NGC., planets and add up to 59 of your favorites. Epoch 2000 coordinates.
- Liquid crystal display, backlit, heated.
- RS-232 Serial Port

Complete module with encoders and mounting hardware	**$695.00**
Computer Module alone	**$349.00**
Encoders and mounting hardware	**$349.00**

SPECIAL PRICE — $595 when complete digital circles purchased with GM8/G14/G11/G9 Mount.

NEW ACCESSORIES FOR 1997

2x 1.25″ Short Barlow	$45.00
Special 1/20 wave quartz 11/4″ diagonal	$159.00
2″ 1.75x Barlow	$79.95
1.25″ 3x Barlow	$49.00
90° 11/4″ image erect diagonal	$89.00
2″ Basic Camera Adapter	$29.95
2″ Rack & Pinion Focuser for Refractors	$139.00
Crosshair eyep. 21.7MM 52″ Ap Field w/Rubber Eyeguard	$42.95
Piggyback Cam. Mount	$19.95
17.5MM and 21.7 Kellner	$29.00
EZ View Eyepieces 4.5, 7, 11MM	$99.00
17MM EZ View Eyepiece	$79.00
New Super EZ View 3.1MM or 5MM	$119.00

RIGEL SYSTEMS

Starlite Dual LED Flashlight	**$22.00**
Quick Finder	**$35.00**
Illuminated Reticle Pulsing Unit	**$35.00**

TELRAD w/Base
$39.00

Batteries included!

Hinged Deluxe Dew Caps	$10.00
Extra Bases	$ 7.95
Extra Reticles	$ 2.95
Pulsar Unit	$19.95

— DON'T BE LOST IN SPACE! —

Navigate through the heavens with ease this year with our Exclusive Package
- Telrad w/Base
- Planisphere
- Set of Messier Finder Books for Telrad

ALL FOR ONLY $66.00 *plus shipping*

MEADE

We carry the full line of Meade Telescopes & Accessories

EDMUND SCIENTIFIC

Astro Scan 2001 World Famous 4¼″ Portable Reflector Scope $315.00

ASTRO SCAN ACCESSORIES

New Tripod for Astro Scan	**$88.00**
Tripod Bkt. **$49.95** Tote Bag	**$31.95**
Var. Cam. Ad	**$79.95**
Sun Viewing Screen	**$46.95**
St. Thru Image Erector	**$69.00**
Base Mat	**$10.00**

EYEPIECES & ACCESSORIES

11/4″ RKE 8, 12, 15, 21 or 28MM	$42.95
RKE 2.5x Barlow	$67.95

Edmund, Orthos, Kellners, Ortho ZOOM
Sale priced.
ALL EDMUND PRODUCTS AVAILABLE

COMPUTER SOFTWARE

"THE SKY" by Software Bisque

Levels 2 & 3 for DOS or WINDOWS includes CD ROM GSC CD ROM version available.

Sky Pro software and computer scope interface kits in stock.

STARGAZE	$79.00
Red Shift — CD ROM for Mac or Windows	$55.00
Dance of the Planets Standard Edition	$99.
with Stars 8.0	$139.
Dance of the Planets QED Edition	$129.
with Stars 8.0	$169.
Stars 10.0 (requires 8.0)	$55.

EYEPIECE SPECIALS!!

Brandon Eyepieces - Used in Questar
Available in the following focal lengths — 8MM, 12MM, 16MM, 24MM and 32MM.

Buy Direct & Save
Coated and threaded for filters:

11/4″ Kellners 6, 9, 12, 18, 25, 40MM	$34.95
11/4″ Orthos 4, 5, 6, 7, 9, 12.5, 18, 25MM	$49.95

1¼″ ERFLES

16MM	$ 65.00	25MM	$70.00
20MM	$ 69.00	11/4″ 2x Barlow	$39.00
2″ Erfle 32MM	$145.00		
11/4″ 8.4-21 Ortho ZOOM			$95.00

Vixen LV Eyepieces in stock

ACCESSORIES CORNER

T-Rings (spec. camera make)	$10.00
Tele-Extenders & T-Adapters for SCT's	$22.00
Color & Moon Filters 1.25	$12.00
(Set of 6) Color & Moon Filters 1.25	$59.95
Drives for Tasco Eq. Mount	$89.00
Anti-Vibration pads for Tripods	$40.00
Tripod Slo-mo controls	$ 36.00
Celest. F6.3 Reducer/corrector	$118.00
Celest. Photo Deluxe Tripod	$ 95.00
Red LED Chartmaster flashlight	$ 17.50

CELESTRON

CELESTRON

C-5 Plus shown

Sale Prices on All Celestron Scopes and Accessories
Contact us on new Celestron 9.25″ and 11″ SCT's. NEW 6″ and 8″ Dobsonians In Stock!

QUESTAR

We are a stocking, authorized Questar Dealer. Please contact us for sale prices before you purchase!

SPECIAL PURCHASE — 3.5″ STD, Pyrex w/mag. fluoride and power guide. Factory sealed — Call!

ASTRO SYSTEMS

We carry Astro Systems full line of telescope making equipment. Primary Mirror Cells, Secondary Holders, Heavy-Duty Spiders, Teflon Bearing Kits.

Announcing Enhanced Coated Secondary Mirrors
Intro. Prices

1.3″	**$38.00**	**2.6″**	**$ 83.00**
1.5″	**$44.00**	**3.1″**	**$105.00**
1.8″	**$56.00**	**3.5″**	**$219.00**
2.1″	**$68.00**	**4.0″**	**$269.00**
Combo Site 2/Cheshire Tool			**$39.00**

BOOK & STAR CHARTS

MAG 5 Star Atlas	$ 6.50
MAG 6 Star Atlas	$16.95
Sky Atlas 2000 Field or Desk	$19.95
Sky Atlas 2000 Companion	$24.95
Laminated Deluxe 2000 Color	$84.95
Laminated 2000 Field or Desk	$58.95
Burnham's Handbook — All 3 Volumes	$39.95
Norton's Sky Atlas	$44.95
Uranometria Vol. I or II	$39.95
Astrophotography for the Amateur	$18.95
Astrophotography II by Martinez	$18.95
Backyard Astronomers Guide	$39.00
Atlas of the Moon by Rukl	$29.95
Deep Sky Field Guide to Uranometria	$49.95
All About Telescopes by Edmund Scientific	$13.95
How to Choose Binoculars by A. Hale	$ 5.00
1000 +	$33.00
Atlas of Deep Sky Splendors	$24.95
Star Ware	$24.00
Star Testing Astronomical Telescopes	$24.95
Touring Universe Thru Binoculars	$32.00
Messier Album	$21.95

SPECTRA

SPECTRA ACCESSORIES SOLVE FOCUS PROBLEMS FOREVER

with Spectra's Sure-Sharp Optical Grid Focusing method for perfectly focused astrophotos

Sure-Sharp	$135.00
Point Source	$ 59.00
Rt. Angle viewer	$ 49.00
Duo-View	$ 79.00

Spectra Guide/Deluxe Radial Model — Call

Desert Storm Covers

Protect your investment —
Covers available for all size scopes

Dealer Inquiries Invited

Manufactured with a thick mylar "heat resistant" material

4″-6″ Dobs & SCTs	$21.95
7″-8″ Dobs & SCTs	$26.95
10″-13″ Dobs & SCTs	$32.95
14″ SCTs	$38.95
16″-18″ Dobs	$44.95
20″-25″ Dobs	$54.95

Corner of Routes 307 & 502, 104 N P 502 Plaza, Moscow, PA 18444

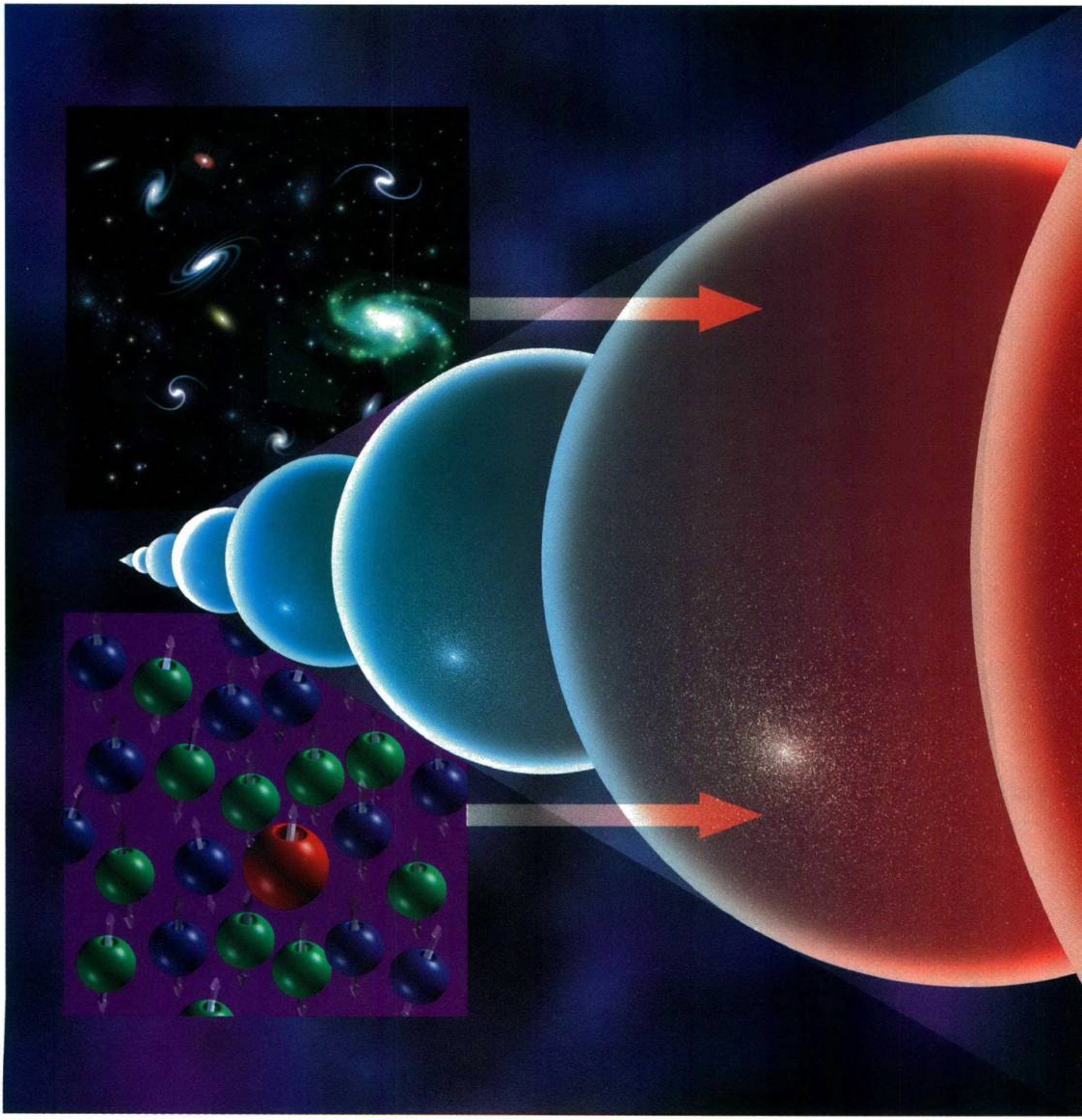
We purchase and take in trade used telescopes
$6.00 MINIMUM SHIPPING - U.P.S. (IN U.S.)
Speak with amateur astronomers . . . ASK FOR GLENN-ARS: K3WEI, DON KD3LN, MIKE, DAVE OR STEVE
Catalog, send check: $6.00 (within U.S.) $9.00 to Canada $15.00 Elsewhere
Purchase orders from qualified institutions gladly accepted.

VISIT OUR HOME PAGE:
http://www.Astronomy-Mall.com

No Surcharge on Credit Cards

WORLDWIDE SHIPPING
Price List — 25 pages — send SASE #10 env. w/64¢ in stamps

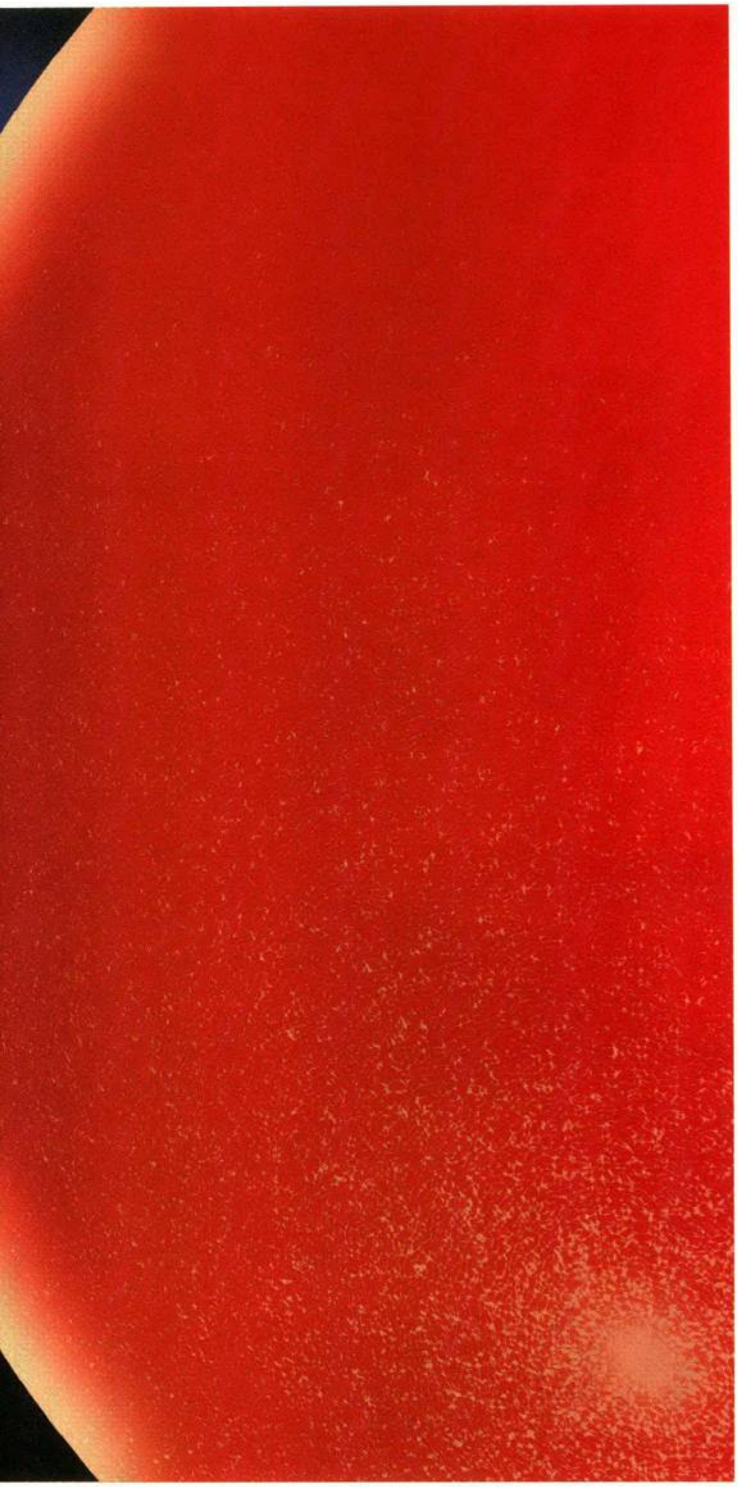
Inflating



George Krauter

From THE WHOLE SHEBANG by Timothy Ferris. Copyright © 1997 by Timothy Ferris. Reprinted by permission of Simon & Schuster, Inc.

the Cosmos



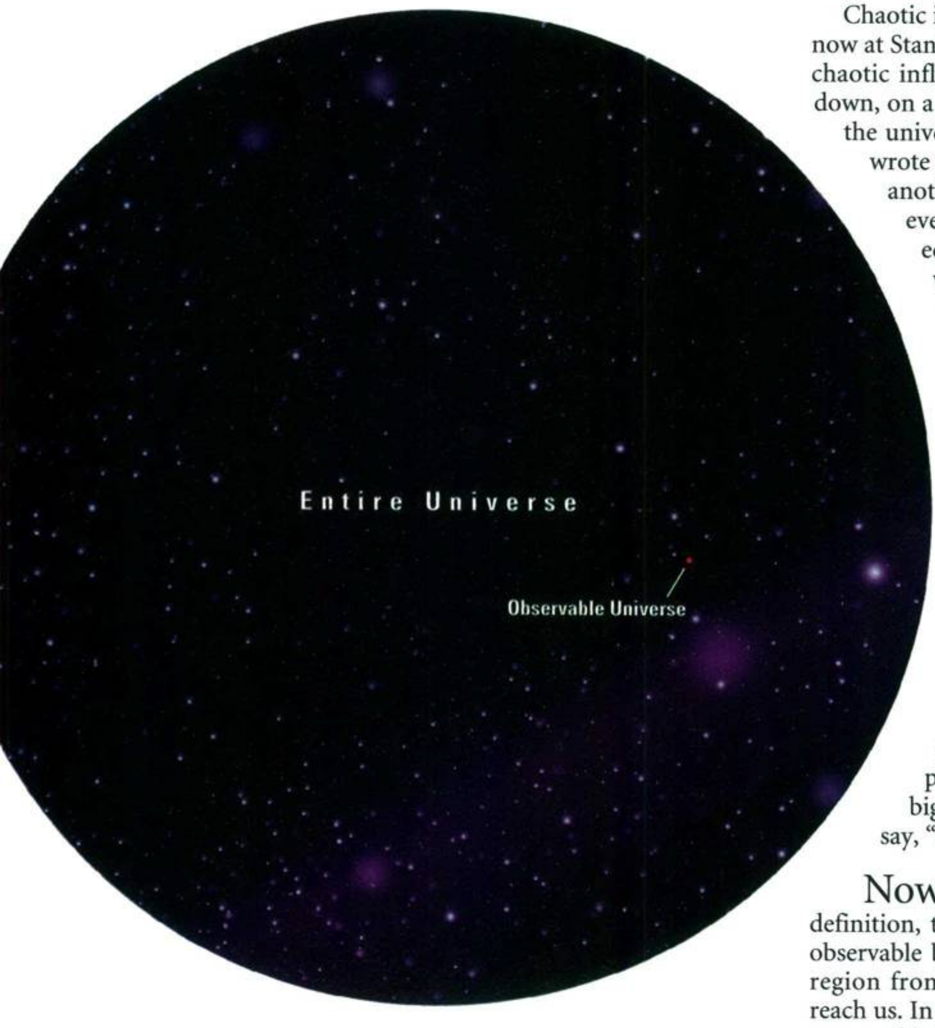
Cosmologists believe the infant universe experienced a brief hiccup, inflating in size a zillionfold.

by Timothy Ferris

Like the Arabic invention of the zero or Einstein's realization that a falling man feels no force of gravity, inflation is a simple idea with multiple implications. Baldly stated, the inflationary hypothesis doesn't sound like much. It asserts that the infant universe underwent a spasm of exponential expansion, a fraction of a second during which it repeatedly doubled its radius over equal intervals of time. (During exponential expansion the radius of the universe increased with each tick of the clock as R = 1, 2, 4, 8, 16 . . .) This historic hiccup was over within 10^{-34} second, an interval compared to which the blink of an eye is an eternity. Thereafter the universe settled into the linear expansion rate (R = 1, 2, 3, 4, 5 . . .) that has characterized it ever since.

Yet inflation may well rank among the most productive ideas of modern cosmology. It provides a physical explanation for cosmic expansion, thus addressing the riddle of how the universe started expanding in the first place. It cures the classic big bang model of its most troubling intrinsic difficulties: the *flatness* problem, which refers to the universe's eerie closeness to critical density, and the *horizon* problem, which relates to the puzzling fact that matter is distributed evenly over the universe's entire expanse — despite the fact that this distance is too vast for information to have traversed it since the Big Bang.

Big Bang With Inflation



Although the inflationary "epoch" was unimaginably brief, its consequences were literally enormous. During inflation, the radius of the universe would have multiplied many times. At the start of inflation, the universe was smaller than a proton. But if you keep doubling even a minute quantity, it soon gets big. The concept of exponential increase has long been illustrated by the story about a young man who persuades a mathematically challenged monarch to reward him if he succeeds in rescuing the king's lost daughter. The reward is to be amassed by placing a penny on the first square of a chess board, two pennies on the second square, four on the third, and so on, until all the squares on the board are covered. Once his daughter is returned, the king learns to his horror that the reward is more than he can come up with; indeed, it is far more than the total wealth of all the civilizations in the history of the world.

Even if we take a modest inflationary model, one in which the universe balloons to only about the size of a medicine ball, the familiar, linear expansion that follows will double that radius another 90 times or so over the course of the next 10 billion years, yielding a universe that today is much larger than it would have been had inflation never taken place. And if we use the estimates of chaotic inflation, the figures become truly Brobdingnagian.

Chaotic inflation is the work of cosmologist Andrei Linde, now at Stanford University. When Linde was first developing chaotic inflation, he explained the theory to me by jotting down, on a scrap of white paper, its estimate of the radius of the universe. Using a thick, felt-tipped black pen, he first wrote a 10, then an exponent of 10, then raised that by another factor of 12. This was the largest number I'd ever seen. It beggared the term "astronomical." It is equal to a 1 followed by a trillion zeros. Had Linde written a 1 followed by a trillion zeros on a strip of ticker tape, the paper would girdle the Earth two dozen times. To print it here for the reader's edification, in small type, would require that this magazine be millions of volumes in length — the capacity of a good university library. Gaping at Linde's 10 to the tenth to the twelfth, I asked one of the stupidest questions of my life: "In what units is that expressed?" I inquired. "I mean, is it centimeters? Light-years? Parsecs? Hubble radii?"

Linde laughed. "Well," he replied, "when you're dealing with 10 to the tenth to the twelfth, it doesn't really matter what units you're using." Actually he had in mind the radius of the universe in centimeters, but the point is that the inflationary universe is not just big but, as the variety show host Ed Sullivan liked to say, "*really* big."

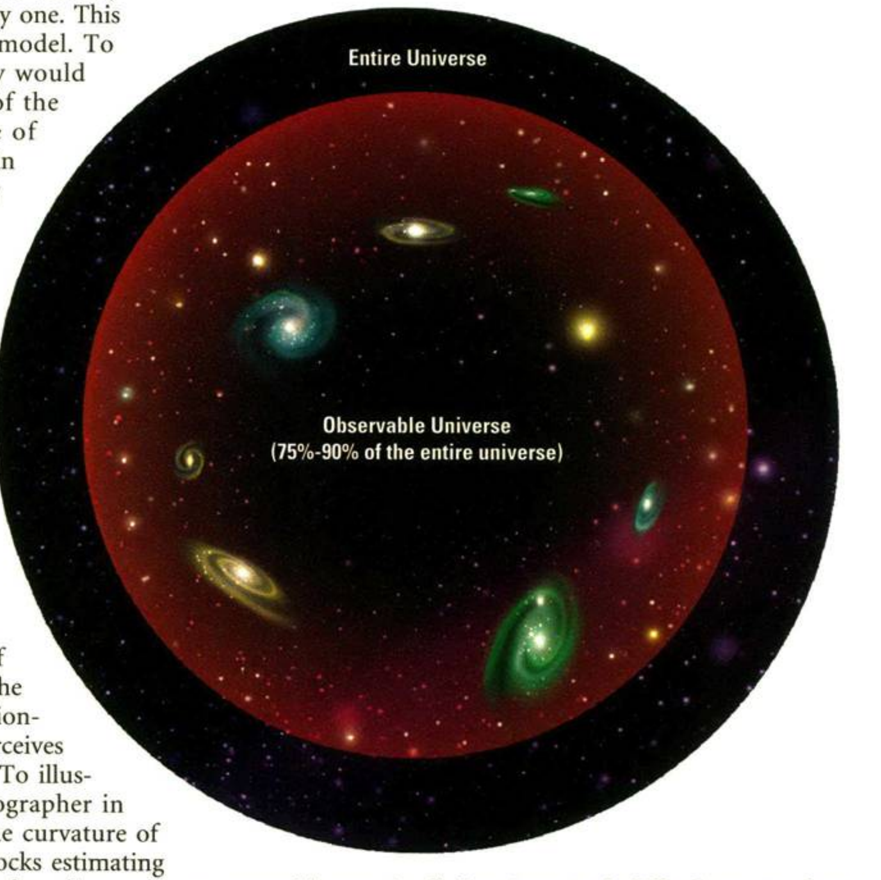
Now, while "the universe" comprises, by definition, the totality of all the regions that are potentially observable by us, the *observable* universe is restricted to the region from which light signals have already had time to reach us. In the classical big bang picture, this distinction was not terribly important; in that model the observable universe amounted, depending on the geometric particulars, to something like 75 to 90 percent of the entire universe. But because the universe in the inflationary model is gigantic, the observable part of it is only a tiny fraction of the whole.

One important effect of this radically altered relationship between the size of the observable universe and that of the universe as a whole is to flatten cosmic space. The geometry of cosmic space is remarkably flat, meaning that omega —

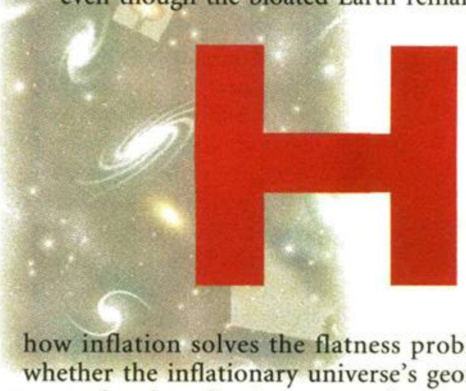
the ratio of the amount of matter required to close the universe versus the amount of matter that is actually contained in the universe — is approximately one. This fact is inexplicable in the classic big bang model. To make cosmic geometry come out that way would have required extraordinary fine-tuning of the initial conditions: The primordial value of omega had to be set to one within one part in 10^{60}. God might have been up to it, but why should he have gone to the trouble? Attention was drawn to the flatness problem by James Peebles and Robert Dicke at Princeton back in 1979, but no solution could be found within the classical model.

Inflation provides a straightforward explanation of why cosmic space should appear to be flat. The classical big bang model, since it envisioned the observable universe as constituting the lion's share of the entire universe, permitted observers to behold the global geometry of space. Their situation was rather like that of comic strip characters standing on a small spherical planet who can tell just by looking around that the surface of the planet is curved and can easily measure the extent of its curvature. But because the inflationary universe is much bigger, any observer perceives the surface (i.e., the shape of space) as flat. To illustrate this effect, imagine that you are a geographer in ancient Athens and you want to measure the curvature of Earth. You spend a few days down at the docks estimating how far ships have to sail out to sea before they disappear over the horizon. Soon you have derived a plausible estimate of the curvature of Earth's surface.

Big Bang Without Inflation



This represents the classic big bang theory, in which we can see most of the entire universe and so can measure the curvature of cosmic space. Now inflate Earth a zillion times. (Actually many zillions, but enough of that.) The horizon appears to be perfectly flat — you cannot measure any curvature: outgoing ships shrink to dots but *never* disappear — even though the bloated Earth remains spherical. That's how inflation solves the flatness problem. Regardless of whether the inflationary universe's geometry ultimately is open, closed, or flat, it *appears* to be flat, since we cannot see enough of it to discern its true curvature.



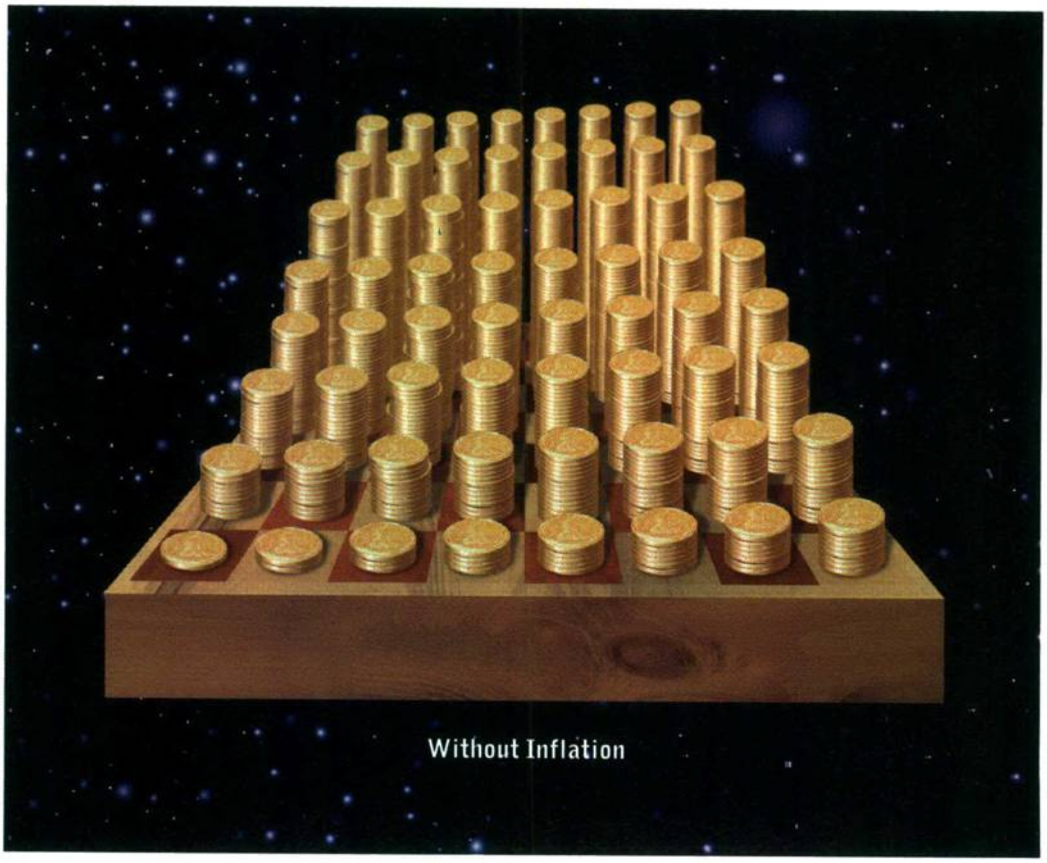
How did photons from two different regions ever "learn" to emit at exactly the same temperature?

Similarly, inflation resolves a major problem that beset the classic big bang model — the riddle of why the universe should exhibit *homogeneity*, meaning that matter on the large scale is distributed evenly; and *isotropy*, meaning that matter on the large scale is distributed in comparable ways in all directions. Both difficulties arise from the relationship between the observable universe and the entire universe in the classic model. Since the observable universe is the region within which information can have been exchanged, it also defines the largest area within which cause and effect can have operated.

The trouble was that in the standard big bang model, given the velocity of light and the age of the universe, objects on opposite sides of the observable universe could never have been in physical contact nor otherwise have exchanged information with one another. If that were the case, astronomers examining the cosmic microwave background radiation on opposite sides of the sky today would be looking at disconnected and dissimilar regions; indeed, the two regions would be separated from each other by 90 discrete horizons. Not only would they reside outside of each other's observable universe, but 88 observable universes would lie between them. Trying to get a message across the classical big bang universe would have been harder than sending a letter through 90 nations, none of which handled the postal traffic of any of the others. In fact, it would have been impossible. Yet the cosmic background radiation looks much the same all over the sky. How did photons from one region of the universe ever "learn" that they were to emit at exactly the same temperature as photons in another region of the universe? How did electrons on one side of the universe learn how to be identical to the electrons on the other side? This is the horizon problem.

Inflation delivers both the local lumpiness and global smoothness that characterize the universe we live in.

At first glance, inflation would seem to make the horizon problem worse, since it postulates a more rapid cosmic expansion rate near the outset of time. Instead, inflation eliminates the horizon problem. It does this in two ways. First, since inflation need not have begun at time zero, it permits scenarios in which the primordial material remained concentrated long enough to mix before inflation got under way. Second, inflation delivers a homogeneous universe by getting rid of primordial lumps. Suppose you are observing the Alps. You note that they are lumpy. Now inflate Earth to a zillion times its former radius. The Alps are still there, but the horizontal dimension has increased so radically that you don't notice them. Even if you were standing on Matterhorn's peak, your surroundings would now look as flat as a tabletop. No more lumps. So all observers in post-inflationary universes find that matter on large scales is distributed homogeneously. As Linde writes, "Inflation remains the only theory which explains why the observable part of the universe is almost homogeneous."



All illustrations by *Astronomy*: Elisabeth Rowan

While accounting for the smoothness of the universe, inflation also handily predicts its departure from smoothness — the existence of large-scale structure in the distribution of galaxies — on a level consistent with what astronomers using the COBE satellite have observed in the cosmic microwave background (about one part in a hundred thousand). That's because inflation would have amplified random, subatomic quantum fluctuations in the early universe, producing the inhomogeneities seen in the COBE data. Left to themselves, these quantum fluctuations would quickly have subsided, to be replaced by others in the perpetually restless shuffle that characterizes the quantum world. But inflation freezes them in, bequeathing them to the post-inflationary universe as the seeds of large scale structure.

The mechanism hinges on the relationship between the wavelength of a given field (such as an electromagnetic field) and the length of the Hubble radius. (The Hubble radius is that of the observable universe; it defines the zone of causal contact at a given moment in cosmic history. Today its length is roughly 15 billion light-years. During inflation, it was only a fraction of a light-second.) As the universe inflates, the fields carrying quantum flux information grow exponentially in wavelength. When the wavelength of a given fluctuation exceeds the Hubble radius, its amplitude freezes while its wavelength continues to grow. At the end of inflation, such a frozen field emerges looking like a classical field, creating inhomogeneities in the cosmic distribution of mass. So inflation evidently can deliver both the local lumpiness and the global smoothness that characterize the universe we live in.

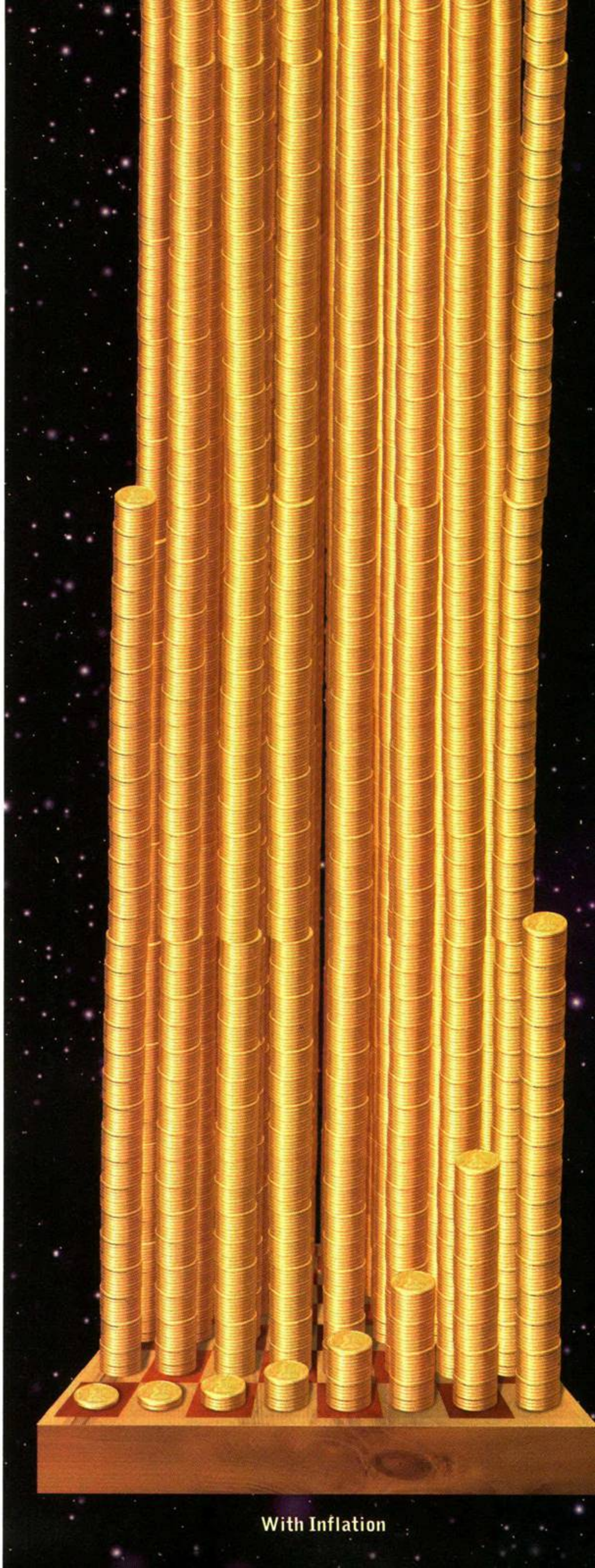
As a final advertisement, I should mention that inflation does away with the *magnetic monopole* problem. In the early universe, the vacuum of space underwent phase transitions, much as boiling water evaporates into steam. These phase transitions broke a hypothetical primordial force into the four forces manifest today — the electromagnetic force, the nuclear strong and weak forces, and gravity. Such a universe would have been fraught with so-called Higgs fields, which are said to have endowed particles with mass. Knots in the Higgs fields should have generated lots of magnetic monopoles. These are massive particles that have only one magnetic pole (all other known particles have two poles: a negative and a positive pole). Never yet observed, but reasonably well established in theory, monopoles are alluring objects, little onions whose anachronistic layers retain the primordial physics that ruled the early moments of the universe.

The trouble is that in the classical big bang picture there were far too many of them. The calculated monopole density would have made the universe dense enough to halt cosmic expansion only 30,000 years after the Big Bang. Inflation obviates this difficulty by diluting the density of monopoles and sweeping those few that are produced to regions far outside the horizon of the observable universe. Enormous numbers of monopoles could have arisen in the inflationary universe, yet we and all other observers would find them to be rarer than snowballs in the Sahara. Calculations suggest that inflation would spread them so thin that the average observer could expect to find only a single monopole in the entire observable universe.

In part because it resolves so many problems, inflation seems a good bet to become part of the standard big bang cosmology — or, more properly, to paint a broader picture within which the Big Bang would itself be subsumed. It is original. The Berkeley astrophysicist Joseph Silk exaggerates less than one might think when he asserts that "inflation is the only new idea in cosmology since Einstein." It is general in scope, interfacing adeptly between the classical physics of general relativity and the quantum physics of subatomic particles and fields. It resonates well with string theory, since both would build the foundations of the cosmos out of space itself. It offers adept explanations of why the universe is isotropic and homogeneous (the stretching of a wrinkled balloon) and how galaxies nevertheless came into being (they were seeded by density perturbations that originated in quantum flux).

Inflation has already made two testable predictions, that the cosmic matter density should be critical (as it is confirmed to be, within a factor of 10) and that the spectrum of primordial density fluctuations should be scale invariant (as was detected in the cosmic microwave background by the COBE satellite). And, always important in science as in art, the inflationary hypothesis is fecund; it raises new and intriguing avenues of inquiry. Linde speaks grandly but not groundlessly of inflation as "a new cosmological paradigm . . . much more interesting and complicated than what we have expected."

Timothy Ferris is the award-winning author of the bestsellers Galaxies, Coming of Age in the Milky Way, *and* The Mind's Sky. *He is on the faculty of the University of California, Berkeley, and is a member of* Astronomy's *editorial advisory board.*



With Inflation

KA-BOOM!

How Stars Explode

Some of the wimpiest particles in the universe power the awesome destructive fury of an exploding star.

by Robert Naeye

FOR MILLIONS OF YEARS, THE MASSIVE STAR Sanduleak –69°202 was the master of its domain. At the height of its powers, the star was so big that 170,000 suns would have fit inside. Weighing in at 20 solar masses, Sanduleak –69°202's nuclear furnace pumped out so much energy that the star shone with the brightness of 20,000 suns, dominating its region of the Large Magellanic Cloud. But like many Egyptian pharaohs, this mighty star's glory would prove to be short-lived.

One day, its nuclear furnace ran out of fuel. In a fraction of a second, the core collapsed, triggering a shock wave. The shock wave ripped through the outer layers, blowing the star to kingdom come. Poor Sanduleak –69°202 was no more.

For 167,000 years, news of the star's catastrophic demise traversed space at the speed of light, until on February 23, 1987, it reached a small, rocky planet called Earth. Astronomers on Earth have combed each photon of light they could get their hands on to help them better understand the story of stellar death.

The fact that massive stars end their lives in titanic blasts called supernovae is old news. Astronomers have known that since the 1930s. But how do stars explode? Surprisingly, scientists are just now gaining a detailed understanding of this process. The key development has been high speed supercomputers, which can unveil the immensely complicated and messy goings-on that occur deep inside an exploding star.

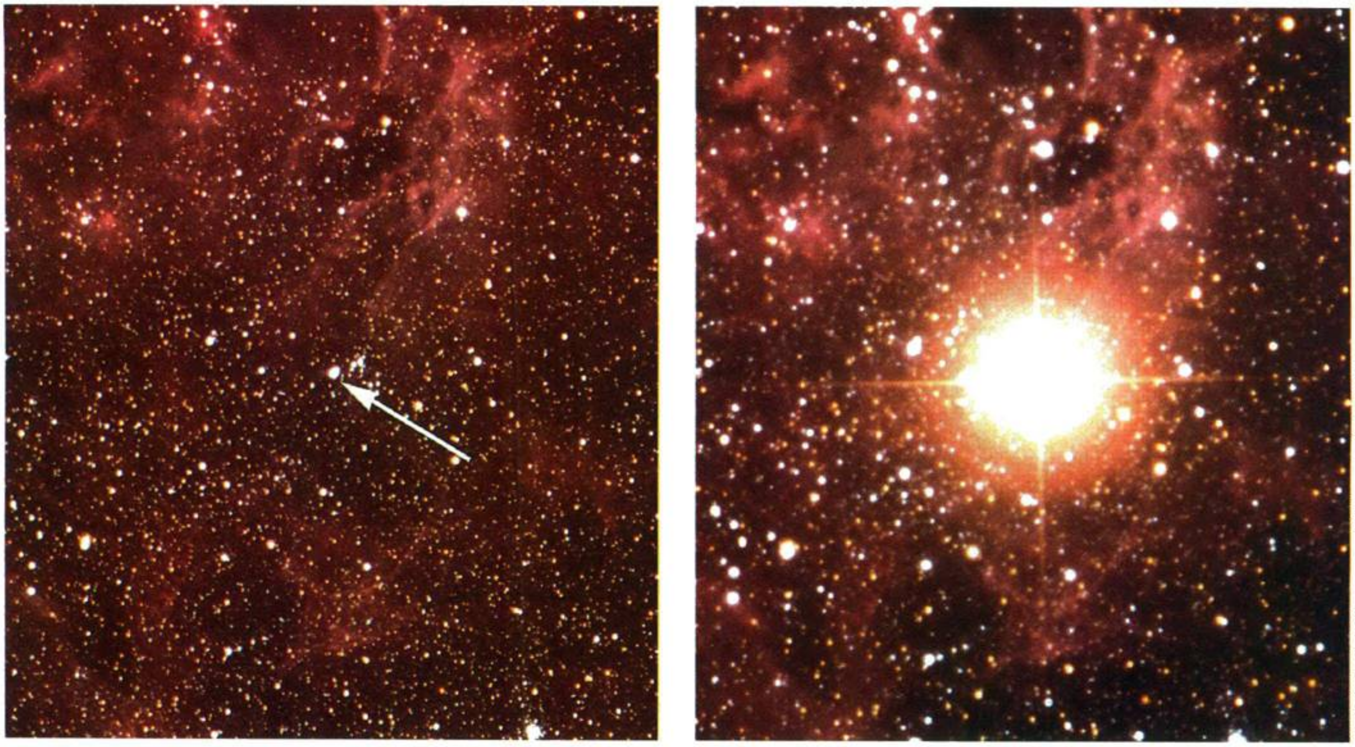
Despite their immense size, stars are rather simple objects. A star, no matter how big or how small, lives its life on a high wire, carrying out a delicate balancing act. It generates energy from nuclear reactions in the core. This energy, in the form of heat, exerts a gas pressure that pushes outward while gravity tries to pull the star inward.

No matter how big the star, it spends most of its life fusing hydrogen atoms into helium deep down in its core. This reaction, similar to the one that powers a hydrogen bomb, generates enormous amounts of energy and helps prevent the star from contracting. But eventually the star will run out of its hydrogen fuel reserves. For the star, this is equivalent to a near-death experience.

But stars are feisty creatures with a built-in safety mechanism, so they always manage to survive this crisis. When a star runs out of hydrogen, gravity causes the core to contract. The contraction heats the star's interior, which increases the outward push of gas pressure. This causes the star's outer envelope to expand and cool: The star becomes a bloated red giant. The contracting core becomes hot enough to begin

Supernovae spew their debris over the surrounding region of space, leaving behind glowing remnants such as the famous Crab Nebula (M1) in Taurus. The iron in our blood, the calcium in our bones, and the oxygen we breathe were forged inside dying stars. Ironically, the death of a star seeds the galaxy with the raw ingredients for the next generation of stars, planets, and life.

Sven Kohle and Till Credner (Astronomical Institutes of the University of Bonn)



Ten years ago, Supernova 1987A graced the skies of the Southern Hemisphere. The explosion occurred 167,000 light-years away in the Large Magellanic Cloud. It was the first supernova visible to the naked eye since 1604. Despite its dazzling appearance, SN1987A was a somewhat fainter-than-normal supernova. These stellar cataclysms can sometimes briefly outshine an entire galaxy in visible light.

Anglo-Australian Telescope Board/Photography by David Malin

fusing helium into carbon and oxygen. This round of fusion gives the star a new lease on life.

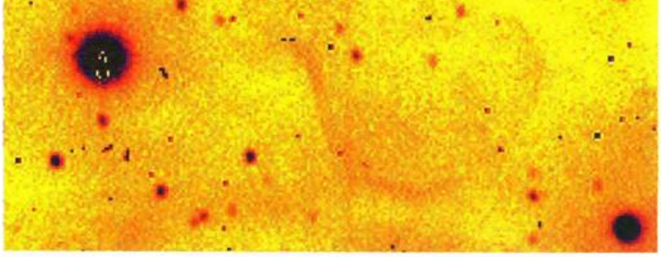
Low-mass stars like the sun end their lives in a whimper. After the core runs out of helium, the core contracts and heats up again. But the temperature never gets hot enough to ignite another round of fusion. The core continues to contract until gravity scrunches the atoms together to the point where electrons exert their own pressure, preventing the core from collapsing any further. The core is a stellar cinder called a white dwarf. A white dwarf, about the size of Earth, is destined to slowly cool and fade for billions of years. Before dying, the bloated star sheds its outer layers of gas, which briefly form a brightly glowing planetary nebula around the white dwarf.

Stars that start out with about 11 or more solar masses end their lives in a blaze of glory. When the core runs out of helium, it shrinks. But the massive overlying layers compress the core to a density where it can become hot enough to fuse carbon, oxygen, and even heavier elements in succession, until the core is made up of iron. At this point, the star's internal structure resembles an onion: An iron core is surrounded by a layer of silicon, which in turn is surrounded by shells of increasingly lighter elements.

Iron is like a stop sign. It has the most stable nucleus of any element — it takes more energy to fuse iron than the reaction gives off. So when the core is made of iron, fusion reactions come to a halt, and the star is ready to meet its doom.

When an iron core exceeds the mass of 1.44 suns — the maximum mass of a white dwarf — gravity takes over and initiates a catastrophic collapse. In less than a second, the core shrinks from a sphere about the size of Earth to a sphere the size of a small city, attaining the density of an atomic nucleus. All the protons and electrons in the core squeeze together into neutrons. The resulting stellar cinder is called a neutron star. A sugar-cube-sized lump of neutron star material contains as much mass as the entire human population.

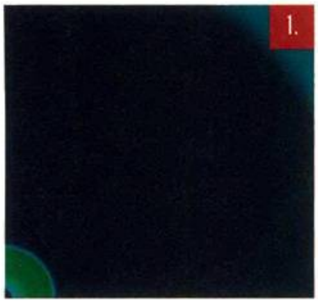
This time the neutrons bunch so closely together that they exert their own pressure, which prevents the core from



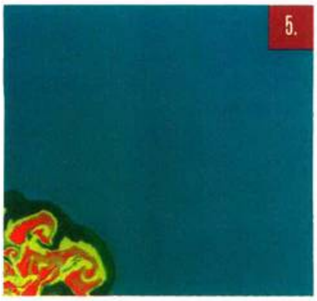
If the supernova is asymmetric, a slight excess of neutrinos flying off in one direction can give a "kick" in the opposite direction to the resulting pulsar or black hole. Astronomers have in fact observed pulsars racing through the galaxy like bullets. Here we see the fastest-moving pulsar known, which is zooming through the galaxy at 1,000 miles per second. The pulsar is moving so fast that it will easily escape the Milky Way's gravitational clutch. The pulsar plows through interstellar gas, forming the so-called "Guitar Nebula."

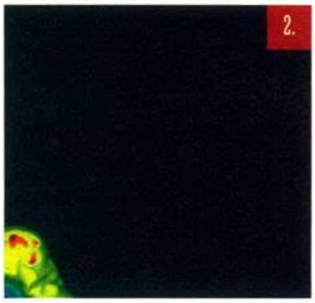
James Cordes (Cornell University)

1. The star's core (dark blue) sits in the lower-left corner, 0.3 second before it will explode. The colors represent different gas densities, pressures, and temperatures, all of which decrease the farther they are from the core. The density of material in the inner core is so great that each cubic micrometer of material (which is much smaller than a bacterium) has the energy equivalent of a hydrogen bomb.

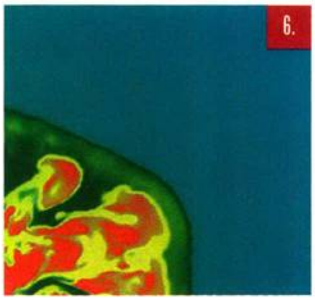


5. About 0.04 second after the explosion, the shock wave, which is now about 750 km from the core, has gobbled up the oxygen/silicon boundary. Huge plumes of hot material — heated by neutrinos emanating from the core — are pushing the shock wave outward.



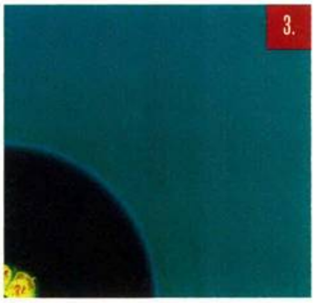


2. A mere 0.02 second before the explosion, the core has collapsed and rebounded. The rebounding core has produced a shock wave that is moving outward. The region just outside the core is boiling. The shock wave is located at the boundary between the boiling region and the dark blue outer layer, which is comprised of silicon. The gas in the dark blue area is falling inward toward the core. The red splotches inside the shock wave are hot, buoyant bubbles of gas that act like expanding balloons. Green represents denser material that tends to sink. The red buoyant bubbles are gas heated by neutrinos emanating from the core. As they rise upward, like hot water rising from a boiling pot, they push the shock wave ever outward.

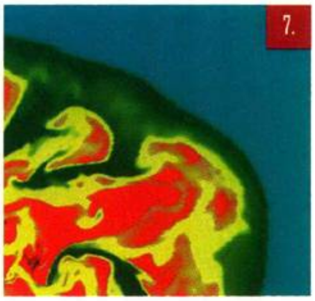


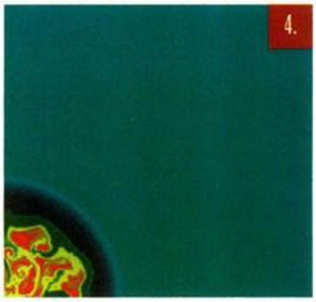
6. By this point, it's clear that the chaotic, turbulent motions below the shock wave are not driving it outward in a spherical manner. Small deviations from perfect symmetry grow with time, creating an asymmetry in the explosion. Many supernovae, including Supernova 1987A, spew their material out in clumps, perhaps leading to many asymmetrical supernova remnants.

3. The explosion is just under way. The lighter blue region in the upper right is made of oxygen, both the oxygen and silicon layers are falling inward at about 10,000 km per second. In just a few milliseconds, they will collide with the shock wave, which is traveling outward at 30,000 km per second.

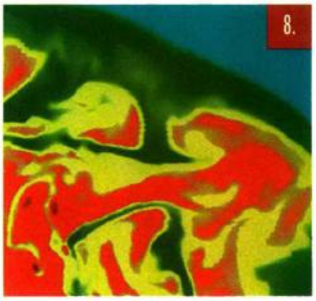


7. About 0.08 second after the explosion, the shock wave has ripped through the inner part of the star. It's important to remember that this is just the central 2,500 km of a star hundreds of times larger than the sun. But in about a day, the shock wave will rip through the entire star. When the shock wave reaches the surface, the star might shine as bright as its host galaxy in visible light. Such is the violence of a supernova.





4. The red buoyant plumes are created by instabilities that arise whenever a heavy gas overlies a lighter one. These instabilities drive convection: whereby hotter material rises and cooler material sinks. The convection thus pushes the shock wave ever outward. The oxygen and silicon layers continue to fall inward.



8. This is the central region 0.3 second after the core collapsed. The inexorable scrunch of gravity will cause the core to shrink even further. Eventually, it will form either a neutron star — a city-sized ball of superdense neutrons weighing more than the sun — or a black hole. Neutron stars are also called pulsars.

All images on this page: Adam Burrows (University of Arizona), John Hayes (University of Illinois), and Bruce Fryxell (NASA/GSFC)

collapsing any further. The core rebounds with 100 billion g's of acceleration (an F-16 fighter pilot can withstand about 10 g's at most). This violent action helps trigger a shock wave that rips through the star and tears it to shreds.

But things aren't quite that simple. Without an outward pressure emanating from the core, gravity causes the star's outer envelope — previously unaffected by the cataclysmic happenings in the core — to start falling inward. Until recently, astrophysicists who modeled supernova explosions couldn't get a star to explode in their computer models because infalling material would ram into and overpower the shock wave, causing it to peter out before breaking out of the core. Because nature has clearly found a way around this problem, getting a star to actually explode inside a computer was one of the biggest unsolved problems in astrophysics.

Now if you're an astrophysicist, subatomic particles called neutrinos come to the rescue. If you're a star, maybe you're not so crazy about these little critters. The breakdown of iron in a star's core produces 10 billion trillion trillion trillion trillion of these massless or virtually massless particles, which stream out of the core at near-light speed. These ghostly particles could pass through half a light-year of lead as if it weren't there, just like a stream of marbles could easily pass through a hula hoop.

While each individual neutrino carries only a negligible amount of energy, supercomputer simulations show that their enormous numbers enable them to reenergize the stalled shock wave by heating the material underneath it, similar to how a stove's hot burner boils water. The influx of energy creates buoyant plumes of hot gas, which push the shock wave outward, enabling it to rip through the entire star and blow it to smithereens. So ultimately, these incredibly ethereal particles are responsible for one of the most cataclysmic events in the universe.

The supercomputer simulations on page 47 show how a shock wave forms, is energized by neutrinos, and moves outward through a star. The images come from a group of researchers that includes Adam Burrows of the University of Arizona, John Hayes of the University of Illinois, and Bruce Fryxell of NASA's Goddard Space Flight Center in Maryland. The key to their work, and to other groups that do similar research, is the ability of modern-day supercomputers to model supernovae in two dimensions. Until recently, computer simulations only revealed what was happening in one dimension, essentially a straight line from the star's core to its surface. These models fell short because they couldn't fully account for all the turbulent motions going on deep in a star's bowels, which power the explosion.

For these two-dimensional models, supercomputers must perform 300 billion operations per second. The simulations run over a period of about 20 days and perform 1,000 trillion calculations. This gives astrophysicists the resolution required to see processes never before visible.

Even with the new computing power, astrophysicists still don't understand all the details of the turbulent motions inside an exploding star. Burrows's team and others will ultimately need to model supernovae in three dimensions,

See A Star's Death Shroud

Supernova remnants are the gaseous remains of stars that once shone mightily but exploded violently in old age. Although supernova remnants are generally faint and they dissipate on astronomically short timescales (about 50,000 years), several are visible in small telescopes. Perhaps the best are the Veil Nebula (top) in Cygnus and the Crab Nebula (bottom) in Taurus.

The Veil Nebula (NGC 6960, NGC 6992–5) consists of two luminous arcs, the westernmost one apparently bisected by the bright star 52 Cygni. (The photo shows NGC 6992–5, the easternmost arc.) These arcs are visible plainly in a 6-inch scope on a dark, moonless night.

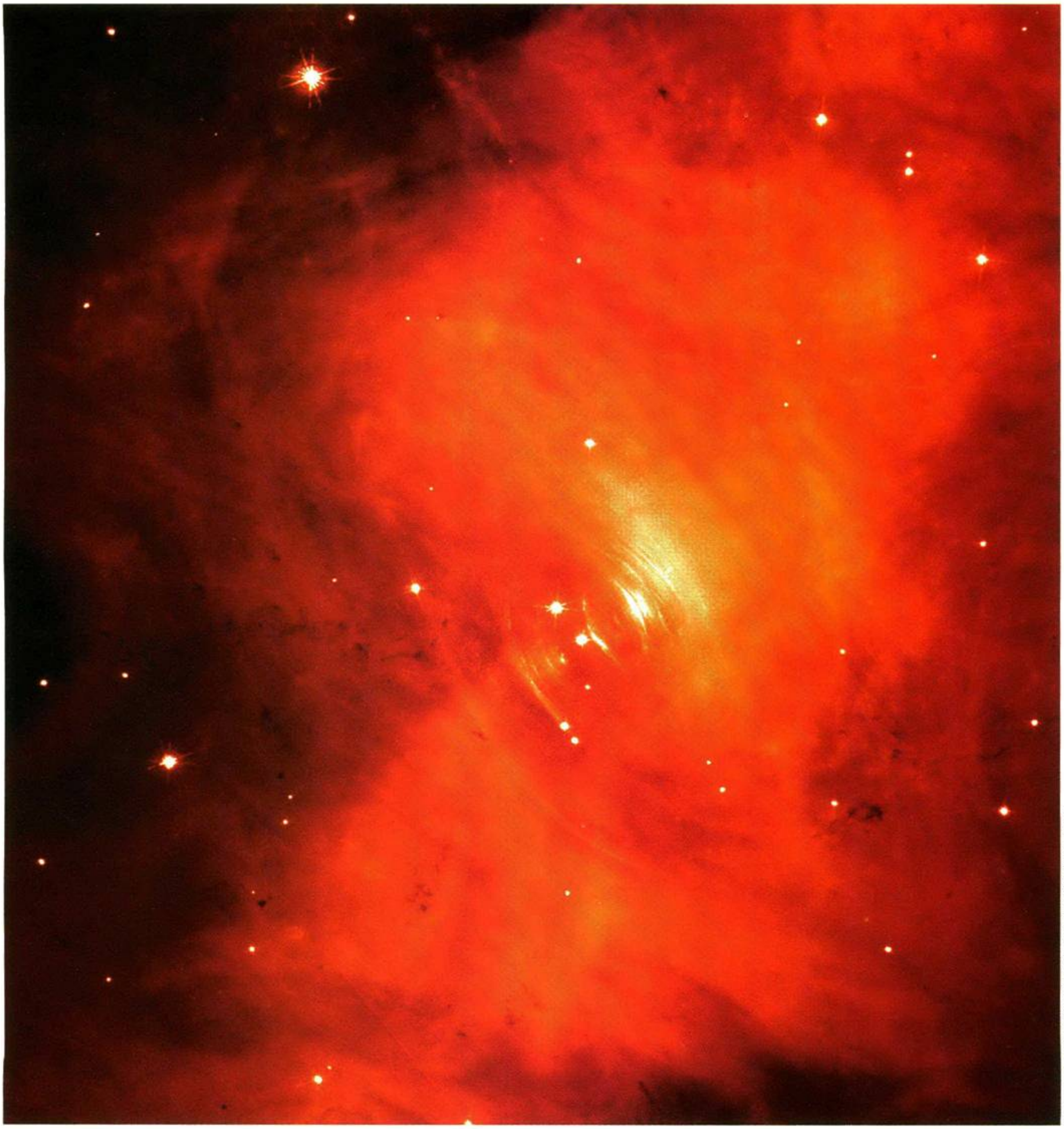
The Crab Nebula (M1), although one of the more challenging Messier objects, appears as a ghostly oval in a 3-inch telescope and shows mottled structure in an 8-inch scope on a good night.

Other such objects include the Vela supernova remnant and Kepler's supernova remnant (3C 358) in Ophiuchus.

— *Dave Eicher*

Bill and Sally Fletcher

Jason Ware



The Hubble Space Telescope zooms into the very heart of the Crab Nebula, an eerie realm where charged particles, caught in the powerful magnetic field of a pulsar, whirl around at speeds approaching that of light. This image, which is a mosaic of Hubble frames, shows a region 7 light-years across. The pulsar is the lower right of the two bright stars in the center.

Jeff Hester and Paul Scowen (Arizona State University) and NASA

necessitating a hundredfold increase in computing power to achieve the same resolution they're getting now. "Over time we hope to develop knowledge, intuition, and insight into what's going on by ratcheting up the level of complexity," says Burrows. "Eventually, our graduate students' graduate students will be doing this in their classes."

During the few seconds that neutrinos stream out of a collapsing stellar core, more energy is released in the form of neutrinos than the energy radiated in visible light during the same amount of time by the trillions upon trillions of stars in the observable universe. Think about that next time you are out under the stars!

Robert Naeye (rnaeye@astronomy.com) is an associate editor of Astronomy *magazine. This article is partially based on his forthcoming book* Through the Eyes of Hubble: The Birth, Life, and Violent Death of Stars, *which will be published this fall by Kalmbach Publishing Co.*

Observer of the
Gas Giants

From the comet-ravaged cloudtops of Jupiter to the dynamic atmospheres of Uranus and Neptune, astronomer Heidi Hammel shows that the outer planets hold surprises. **by Ruth Flanagan**

ON JULY 15, 1994, MIT RESEARCH SCIENTIST Heidi Hammel looked up at a computer screen at the Space Telescope Science Institute in Baltimore, and her heart dropped to the floor. What she saw was a nightmare come true: an image of Jupiter so overexposed that its features were almost entirely lost.

Computer screens in Heidi Hammel's office glow with images of her favorite planets (above). Hammel led the team that observed Jupiter with HST during the Shoemaker-Levy 9 impacts in July 1994 (right).

Photo of Heidi Hammel by Jeffrey Titcomb/HST Comet Team and NASA

Many months before, the 34-year-old astronomer had been given a singular honor: She was to lead the scientific team recording the collision of Comet Shoemaker-Levy 9 with Jupiter's atmosphere using the Hubble Space Telescope at visible wavelengths. It wasn't a stress-free assignment. Since human beings had never recorded such a collision before, no one could say exactly what the teams should look for, nor even exactly where the chunks would fall. So Hammel simply prepared as best she possibly could. She gathered all available information on Hubble's cameras, its orbit, and the trajectories of the fragments. She meticulously choreographed her observing program. She lined up every dress, every shoe, every hairband in her closet with military precision.

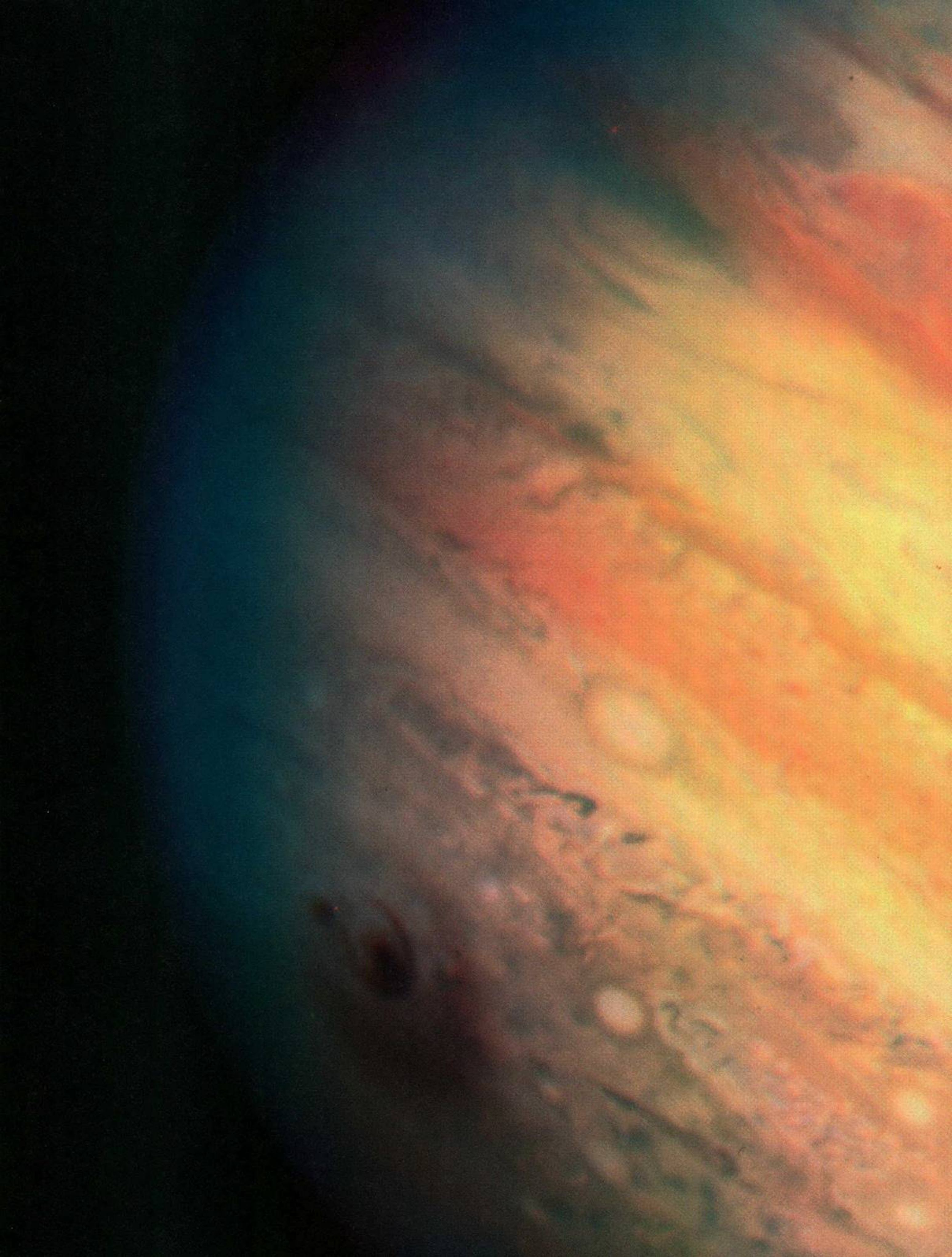
Given her preparations, the sight of the saturated image naturally came as a startling shock. The first fragment impact was one day away. And as she soon learned, all the red-filtered images taken up to that point were seriously overexposed, the green-filtered images slightly so. If the mistake went unchecked, it meant that Hubble would offer scant information on entire regions of Jupiter's atmosphere during the event — an unrecoverable loss.

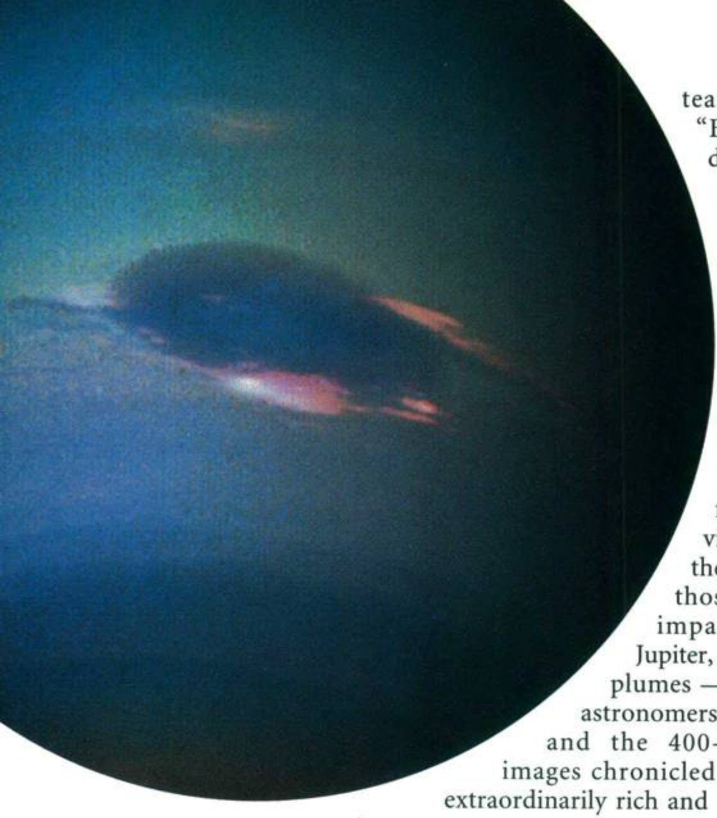
"I thought, 'This just can't be happening. My life has ended,'" Hammel recalls.

Then things got worse. Hammel learned that there was no time to fix the problem. In five minutes the Space Telescope staff was to upload commands to control the telescope for the rest of the week. In fact, she and her colleagues wouldn't even have *seen* the glitch if they hadn't just happened to be in the control room, rehearsing some tricky instrument switches for the impact of the massive G comet fragment, when the image appeared on the screen.

"I told the Space Telescope people, 'You don't understand. We *have* to fix it,'" says Hammel. "They said, 'We can't. It's impossible.'"

After a few go-rounds, a back room huddle ensued, and Hammel prevailed. The Space Telescope staff made an unusual exception for the comet team, granting them five precious minutes to recalculate the exposure times. Five minutes later, the staff whisked away the comet





The Great Dark Spot dominated Voyager 2's view of Neptune in early 1989. The huge feature, shown here in false color, spanned more than 10,000 miles.

NASA/JPL

team's numbers. "By golly, they did their magic," says Hammel. "Everything worked out fine."

By virtually any reckoning, everything worked out far better than fine. The sheer visual drama of the cataclysm — those Earth-sized impact sites on Jupiter, the eerie black plumes — far exceeded astronomers' expectations, and the 400-odd Hubble images chronicled the action in extraordinarily rich and riveting detail. Astronomers came away with a mountain of surprising new data. Equally important, many members of the press and public came away newly inspired by the excitement of planetary astronomy, thanks in large part to Hammel herself.

With her energy and ebullient, non-technical explanations (she spoke of "smooshed-up comet" and jovian "black eyes"), Hammel countered the tired stereotype of the scientist geek. In fact, she very nearly edged out Jupiter as the star of the comet crash. Newspapers wrote appreciative profiles describing her passion for the Grateful Dead, for home-brewed beer. TV reporters nicknamed her "the comet lady," and ran footage of her swigging celebratory champagne as part of the evening news. (That particular incident didn't sit well with the home-brew community, as it turned out. "Champagne?!" beer connoisseurs sniffed over the Internet. "How could she?")

The Shoemaker-Levy 9 experience was unquestionably a pinnacle in Hammel's career. But it is by no means the only peak she has scaled. Last year, the American Astronomical Society conferred on her its prestigious Urey Prize, an award recognizing a young scientist who has made outstanding contributions in planetary astronomy. Hammel received the award largely for her outstanding observational techniques and her painstaking studies of the outer planets' atmospheres. And though this work lacks the overt glamour of her stint as comet celeb, Hammel approaches it with the same sense of mission. Indeed, all of Hammel's scientific efforts so far seem to share an animating theme: that the solar system is far more dynamic, active, and surprising than even many astronomers appreciate.

Observing the Gas Giants

You don't need the power of Hubble to spot the outer planets during July. Easiest of them all to see is Jupiter — the brightest point of light in the sky from late evening, when it rises in the southeast, until dawn.

Uranus and Neptune are trickier because they glow more dimly. (You can glimpse Uranus with the naked eye, but you need binoculars to spot Neptune.) See The Sky Show on page 66 for tips on finding these planets.

Cramped, tidy, and largely unadorned, Hammel's office at MIT offers only one visual reminder of her comet crash days: a misshapen foil star, taped on her door by a fellow astronomer to resemble a Hollywood dressing room. What commands far more attention hangs in the corridor on the opposite wall: a huge photograph of Neptune, its bright clouds set off against a backdrop of deep aquamarine, taken by the Voyager 2 spacecraft in 1989.

Neptune is Hammel's favorite planet, and she has spent the bulk of her career collecting information about its dynamic atmosphere. "The kinds of questions I ask are very simple," she says. "What are the clouds like? How fast do the winds blow?"

But if they are simple to ask, they are not easy to answer. Because Neptune lies about 4.5 billion kilometers from Earth, resolving the features on its tiny disk has always been an extremely challenging task. Hammel's data, including ground-based observations taken before the Voyager 2 encounter, have added significantly to our basic knowledge of the planet. As Tim Dowling, a fellow astronomer at MIT explains, "Heidi was looking at Neptune long before most anyone knew it was interesting. She could see that it was active, with these wild cloud features, well before Voyager 2." Brad Smith, an astronomer at the Institute for Astronomy in Honolulu, Hawaii, concurs. "Her observational work is phenomenal."

Perhaps surprisingly, Hammel never felt any particularly astronomical leanings as a child. No conversion experiences while watching Carl Sagan's

Cosmos. No begging her parents for an observatory in the backyard. In fact, her career in astronomy very nearly ended before it began, while she was an undergraduate at MIT. Overwhelmed with a crushing course load, she'd resolved to drop her first astronomy course. The professor, James Elliot, convinced her to stay, and even drove her to the school's observatory, 40 miles from Cambridge, so she could complete an individual project (taking pictures of asteroids with Polaroid film) on a rare clear night. On the drive back, he recalls asking her, "Are you still going to drop the course?" "Nahhh," she replied. "It's too much fun." (She dropped a history course instead.)

Since astronomy continued to be fun, Hammel went on for graduate work at the University of Hawaii. There she studied everything from galaxies to the structure of distant stars. But she found that her true calling lay closer to home, in the planets of our solar system. For her, planets offered a particular kind of satisfaction: *destinations* for a questing mind. "You feel like you're exploring when you're doing planetary astronomy," she says. "Maybe you're not physically walking on the surface of the planet, but you are exploring it for the first time. You're the pioneer."

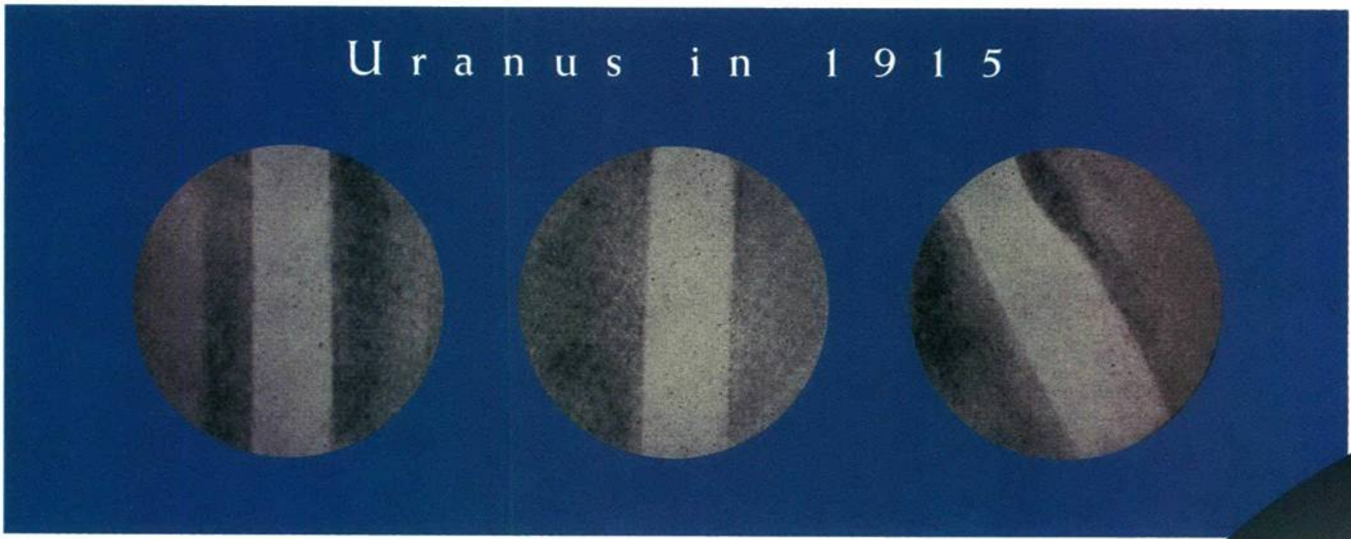
It was partly this pioneering spirit that attracted her to Neptune and Uranus in the mid-1980s, a time when astronomers knew precious few details about the outer planets' atmospheres. Hammel's dissertation work involved taking ground-based images of Neptune at different wavelengths to analyze the cloud structure. Her goal, as she put it matter-of-factly to a housemate one day, was to become the world's expert on Neptune's clouds.

Whether this bold statement impressed her housemate is unclear. But her data, which showed surprisingly dynamic cloud activity, did impress Smith, who was leader of the Voyager 2 imaging team. He invited her to join the large team. The experience was pivotal for Hammel, and, of course, the images Voyager relayed to Earth in 1989 were pivotal in altering people's impressions of Neptune. Far from the benign and listless planet some expected, Neptune proved itself one of the most dynamic planets in the solar system. Voyager revealed winds ripping across the planet at up to 2,200 km per hour relative to the interior; clouds forming and disbanding in mere minutes' time; and, most prominently, an Earth-sized, anticyclonic "Great Dark Spot" churning in the southern hemisphere.

"It's easy now to see how wrong we were about Neptune," says Smith, "but think what we knew at the time. We just assumed things would get less interesting as we moved away from the sun. Jupiter has those bright, contrasty bands. Saturn is a little

Hubble images of Neptune can't rival those from Voyager, but they allow planetary scientists to chart the blustery weather and confirmed the Great Dark Spot's demise.

L. Sromovsky (Univ. of Wisconsin) and NASA


Uranus in 1915

In the early 1900s, visual observations of Uranus revealed several faint bands reminiscent of those seen today on Jupiter and Saturn.

R. L. Waterford

more blah. Uranus is a virtually featureless disk, so we thought well, my God, Neptune is going to be horrible. Voyager changed all that."

Ironically, Hammel's most recent work, using the Hubble Space Telescope, aims largely to *supplant* the Voyager view. Her quarrel is not with the stunning Voyager images themselves, but with what she sees as a widespread assumption that they tell the whole story. The dynamic planets are constantly revising the impressions that the spacecraft left in its wake, she says.

After all, Voyager's "last picture show" was clearly not the last word on Neptune, as Hammel's and others' work shows. In 1994, it was Hammel and her colleague Wes Lockwood at Lowell Observatory in Flagstaff, Arizona, who reported that the Great Dark Spot had simply vanished, replaced by a new spot in the north. (That new spot was apparently still there as of 1996, according to Hubble images taken by Lawrence Sromovsky of the University of Wisconsin at Madison.) Only ongoing observations will reveal how, and ultimately why, such mysterious features arise, Hammel says.

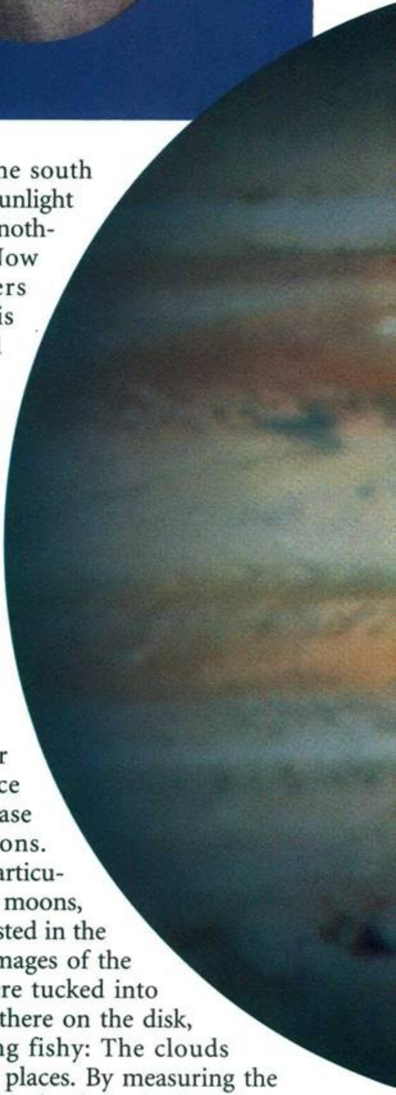
"There's a perception by non-planetary astronomers that heck, we can send spacecraft to these planets. Why should we waste our valuable telescope time looking at them?" she says. "The less people know about these planets, the less people realize how profoundly they change."

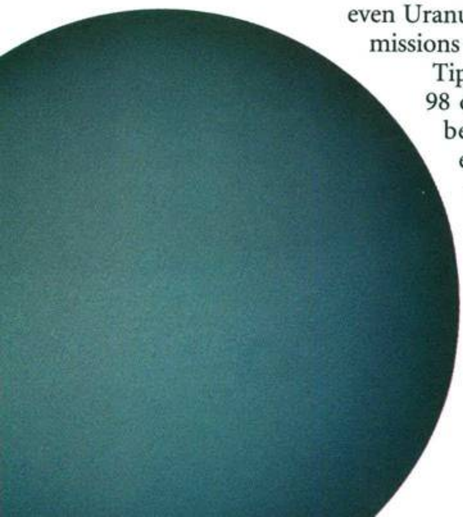
In fact, if Hammel's latest hunches are right, even Uranus — the under-achiever of the Voyager missions — may have big surprises in store.

Tipped on its side (its axis of rotation tilts 98 degrees to its orbit), Uranus has always been an intriguing planet. But it's not exactly a "looker," or at least it wasn't when Voyager flew by in 1986. Even at closest approach, Uranus stubbornly remained what Dowling calls "a bland blue nothing," with just a few bright clouds interrupting the haze. Significantly, Voyager flew by near Uranus's solstice, when the planet's southern hemisphere was beginning its 21-year-long summer and the south pole received all the sunlight while the north saw nothing but darkness. Now Hammel and others wonder whether this was simply the dull season on Uranus. And if Uranus's cloud activity does change dramatically with the seasons, it may soon be time for the planet to "bloom."

Hammel noticed a possible hint of this change last year, in a rather unusual manner. She was sitting at her desk, reading a Space Telescope press release about Uranus's moons. Though she wasn't particularly interested in the moons, she was keenly interested in the three well-exposed images of the planet's disk that were tucked into the press pack. And there on the disk, she found something fishy: The clouds were in the "wrong" places. By measuring the relative positions of the clouds in the three frames, Hammel calculated the speed of the winds that carry them along. Then she compared those wind speeds with the speeds Voyager recorded a decade earlier at the same latitudes. To her astonishment, their pace had apparently slowed.

For Earthlings accustomed to fluky, changeable weather, this might not sound like mind-boggling news. But on Jupiter and Saturn, the only other outer planets for which scientists have sufficient data, wind speeds at any given latitude seem to remain remarkably constant over time. Thus,

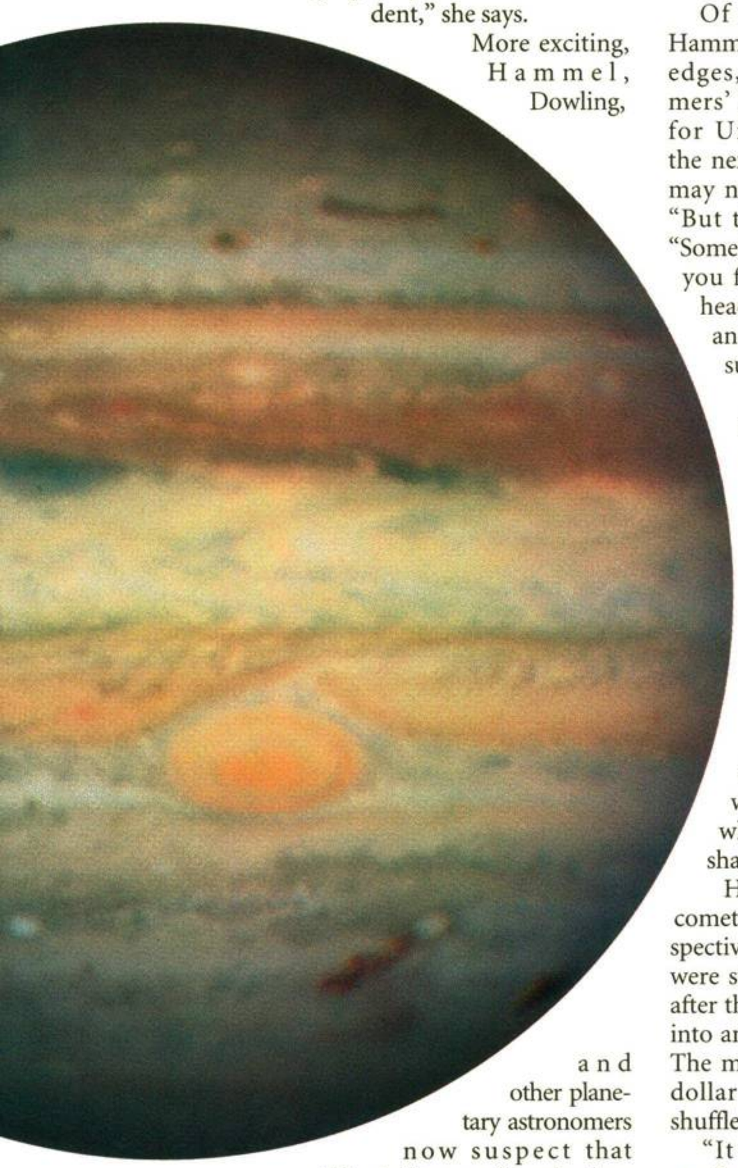



Big, blue, and bland, the Uranus seen by Voyager 2 in 1986 showed few hints of having an active atmosphere.

NASA/JPL

Hammel's finding, if borne out by further research, offers the first evidence of winds changing speed over time in a giant planet's atmosphere.

Preliminary models of Uranus's atmosphere, developed by Dowling and others, also support the idea that wind speeds should change with season, as Hammel discovered. "At first I thought I'd just screwed up the wind speed calculations. But when Tim and I talked about this, suddenly it began to click. I thought, wow, I'm finding that the winds are changing; his models suggest that the winds are changing. Maybe this isn't an accident," she says.



More exciting, Hammel, Dowling, and other planetary astronomers now suspect that this shift may foreshadow more dramatic atmospheric changes to come.

Last October, in her Urey Prize lecture at the Division of Planetary Sciences meeting, Hammel offered some pictures of what this drama might mean. Instead of focusing on the latest images from space, she showed black and white drawings of Uranus, rendered by visual astronomers in the early 1900s. The pictures, reproduced in the classic book, *The Planet Uranus* by A. F. O. Alexander, depict a vastly different planet, decorated with bright, broad bands, and even the hint of something that might be a great spot. Significantly, they were drawn at a time when Uranus was between its solstice and its equinox, the same phase the planet is entering now.

Photo of Heidi Hammel by Jeffrey Titcomb/HST Comet Team and NASA

The impacts of Comet Shoemaker-Levy 9 on Jupiter, and Hammel's role in explaining them to the public, helped turn her into a media celebrity.

Of course, as Hammel acknowledges, astronomers' high hopes for Uranus over the next few years may not pan out. "But that's how science gets done," she says. "Something happens that starts you thinking, and you follow it up." Then she adds, shaking her head slowly, "And if you turn out to be right, and something really radical has happened, it's such an incredible thrill."

Unfortunately, Hammel may not be scrutinizing Uranus as thoroughly as she'd like in the immediate future. Her proposals to observe both Uranus and Neptune with Hubble were rejected for 1998. (Researchers from other institutions will be making observations, however.) Perhaps more importantly, Hammel is also deeply involved in another, even more engrossing project right now: She and her husband, Timothy Dalton, a chemical engineer, celebrated the birth of their first baby this May.

Since she's still adjusting to this major change in her life, Hammel hasn't decided what she'd like to do next in astronomy. But whatever she does, she's certain to continue sharing her work, and her awe, with the public.

Hammel's most cherished memory from comet crash week says a great deal about her perspective. It happened when she and her colleagues were strolling along the pier in Baltimore, shortly after the last comet chunk fell. There the group ran into an enterprising man with an 8-inch telescope. The man was offering turns at the eyepiece for a dollar a pop. So, one by one, the astronomers shuffled up for a look.

"It was just an incredible sight," Hammel recalls. "I had spent months planning the whole thing with Hubble. But I had never physically looked through an eyepiece to see what was happening. When I saw those black spots, it hit me right in the gut. This wasn't something just for astronomers. It belonged to everyone."

Ruth Flanagan, a former associate editor for Astronomy's *sister magazine* Earth, *just completed a Knight Science Journalism Fellowship at MIT.*

Why is there Something instead of nothing?

Why is there a universe at all? How could everything we see around us have been created out of nothing?

by James Trefil

When you begin to think about how the universe began, you naturally wonder what was here before it began. The obvious answer is "nothing." But what, exactly, is "nothing?" The best way to characterize current thinking on this question is to say that "nothing" just ain't what it used to be. For most of recorded history, people have had a problem thinking about nothingness, or the vacuum — indeed, recognition of the very existence of such a state is fairly recent. The reason for this difficulty isn't hard to find. Have you ever tried to picture nothing? I can't do it. I can picture empty space surrounding something (two basketballs, for example), but I can't picture the absence of everything. And this shortcoming of human imagination has influenced our thoughts about nature — scientists accepted the existence of the vacuum only when the results of repeated experiments drove them to do so.

But that acceptance didn't last long. With the advent of quantum mechanics, our picture of nothing changed again. Instead of a passive, inert absence of matter, quantum theory tells us that a vacuum is both active and dynamic. According to the laws of quantum mechanics, a bit of matter can appear spontaneously out of nothing, provided that (1) a corresponding bit of antimatter appears at the same time and that (2) the matter and antimatter come together and annihilate each other (disappear back into the vacuum) in a time so short that their presence cannot be directly measured. This process is called the creation of a "virtual" pair of particles, one of matter and one of antimatter.

Think of the vacuum as a level field and the creation of a virtual pair as like digging a hole and piling the dirt up. You have a particle (the pile of dirt) and an antiparticle (the hole), but when you put all the dirt back in the hole, you're back to the level field.

So the modern vacuum is a little like popcorn popping, except that this popcorn can "unpop" as well. A virtual pair pops up here and un-pops, then another pops up there, and so on. And lest you think this is all a fairy tale, I should point out that occasionally a particle traveling through space, such as an electron, comes near one of these virtual pairs and is very subtly altered by the encounter. That subtle alteration can be detected, so the concept of the quantum mechanical vacuum is backed up by more than just imagination!

So the "nothing" from which the universe sprang was not just the absence of everything but a nothing with virtual pairs of very energetic particles popping up and disappearing all over the place. Exactly how this sort of vacuum led to the universe we live in remains the big question, and all sorts of theoretical speculations have been advanced about how the system might work. Let me talk about my favorite type of theory to give you a sense of how these theories operate.

Think of the fabric of space as being something like the membrane of a very special kind of balloon. The presence of any matter, even virtual pairs of particles, causes the fabric to bulge, and this drains energy from the gravitational field to make matter. If the bending is severe enough, the balloon starts to expand. In this scheme, the virtual pairs pop for a long enough time, and, eventually, enough of them will pop in the same place at the same time to bend the fabric enough to start the expansion going. This is the event we usually refer to as the Big Bang. Oddly enough, calculations indicate that it really doesn't

Stuart Briers

take very much mass to set this process off — about ten pounds packed into a volume smaller than a proton would do the job nicely. In most theories, the energy needed to create the rest of the mass of the universe came from the warping of gravitational fields later on.

This particular version of creation has several interesting aspects. For example, it leaves open the possibility that the process could still be going on and thus that there might be other universes out there. Furthermore, it raises the possibility that we might be able to create our own universes by manipulating matter — what cosmologist Alan Guth calls the "Universe in Your Basement Kit." And finally, it provides writers with some tremendously useful quotes. For example, here's physicist Edward Tyron commenting on the fact that creation may just be a statistical fluke: "Perhaps the universe is just one of those things that happens now and again." A

From the book The Edge of the Unknown *by James Trefil. Published by Houghton Mifflin Company, Boston. Copyright © 1996 by James Trefil. Reprinted by permission. Trefil, an* Astronomy *editorial advisor, is a physicist, writer, and NPR commentator.*

All images: Rogier Windhorst and Sam Pascarelle (Arizona State University), and NASA

Before Galaxies Were GALAXIES

Astronomers are closing in on one of the big questions: How did galaxies come to be?

by William Keel

GALAXIES CAUSE ASTRONOMERS problems. They're lumpy. And yet the earliest light we can see in the universe is smooth. So how did the universe go from smooth to lumpy, and how did galaxies form?

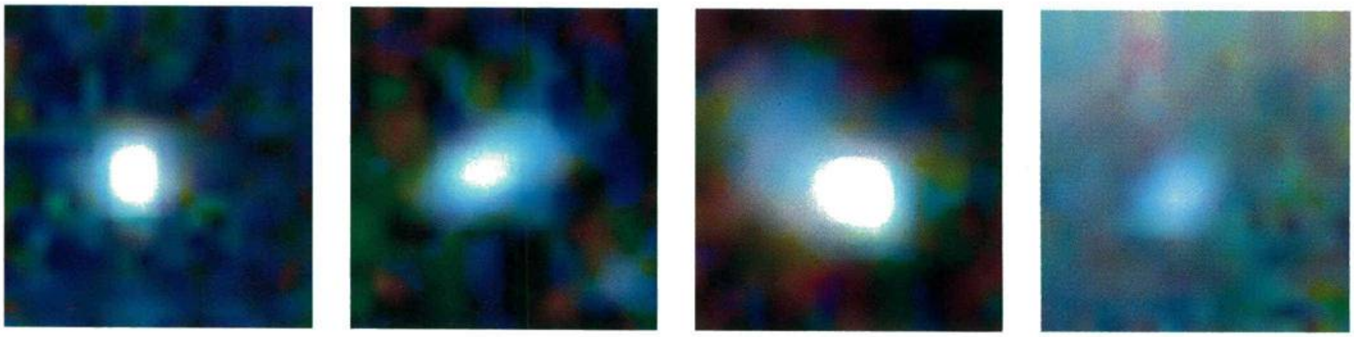
It's one of the great questions of modern astrophysics and cosmology. For many astronomers, searching for the answer has been like the Quest for the Holy Grail, with potential answers constantly receding from view just as they have approached what they thought was the end. Finally, in the last couple of years, new developments may be showing us how galaxies, and the universe as we recognize it today, took form. We can finally look at galaxies — and perhaps their building blocks — within a few billion years of the Big Bang, and dimly glimpse what it all looked like. Fortunately, the picture is richer and more complex than most of the theories predicted.

The Fossil Record

To appreciate the origins of today's ideas, we need to travel back to the early 1960s. Many astronomers grew up with a view of galaxy formation based on an epochal 1962 paper by Olin Eggen, Donald Lynden-Bell, and Allan Sandage, who brought together information on the motions and chemical makeup of stars in our own corner of the Milky Way. They showed that the older stars, poorer in the heavy elements that have been created in the cores of later generations of stars, form a thicker, rounder distribution than the familiar, younger stars such as the sun.

Because the form and extent of a star's orbit is essentially frozen once the star has formed from interstellar gas, the paper argued, the oldest stars orbited in near circles around the galaxy's center while younger stars formed later from the gas clouds that settled into the galaxy's thin, rotating disk. This occurred because the galaxy was a sphere in its infancy, when the oldest stars formed, before the galaxy flattened out and formed the disk. Astronomers see so many old stars in giant, circular orbits that they must have formed relatively quickly. The galaxies must form with a single, smooth collapse, they reasoned.

This so-called collapse picture suggests why we see different kinds of galaxies today. Consider the Hubble sequence for a moment. This classification scheme of elliptical, spiral, barred spiral, and irregular is still so widely used because it does more than Hubble originally intended, which was to describe galaxies on photographs. He used subclasses to indicate the degree of winding of spiral arms or the apparent shape of ellipticals. A galaxy's Hubble type correlates nicely with the kinds of stars it contains, the amount and type of interstellar material it has, and even how its mass is concentrated toward the center. Elliptical galaxies are composed almost solely of old stars, lacking the cool gas needed to make more. Spirals have central bulges of old stars and disks where star formation continues. Irregulars seem to have been making stars at about the same pace for their whole histories. In the collapse picture, ellipticals are the galaxies that were most efficient, leaving almost no gas after their first spree of starbirth, while irregulars are the lazy relatives that made a few stars at the outset and left almost all the gas for later. Because the bulges of spiral and elliptical galaxies are all more or less the same age, there must have been major fireworks in the early universe as all the galaxies contracted and made their first, brilliant generations of stars. It would have been a spectacular view, with galaxies larger, brighter, and much closer together than today, and studded with brilliant star-forming regions and young star clusters — a time we might fondly wish for as we peer at the dim blurs of galaxies in our eyepieces.



By the late 1960s astronomers were in a position to look for signs of how galaxies have evolved. Beyond this, some were thinking ahead to how primeval galaxies, or protogalaxies, might appear. The hunt for primeval galaxies, loosely defined as galaxies forming their first important generation of stars, has been a long-running quest of Arthurian proportions — and, some argue, just as embellished with myth. If most large galaxies really formed during a single short period, they would have been loaded with brilliant, short-lived blue stars, making the galaxies correspondingly powerful. If this were so, the sky would be peppered with primeval galaxies at about 20th magnitude. But these galaxies are nowhere to be found.

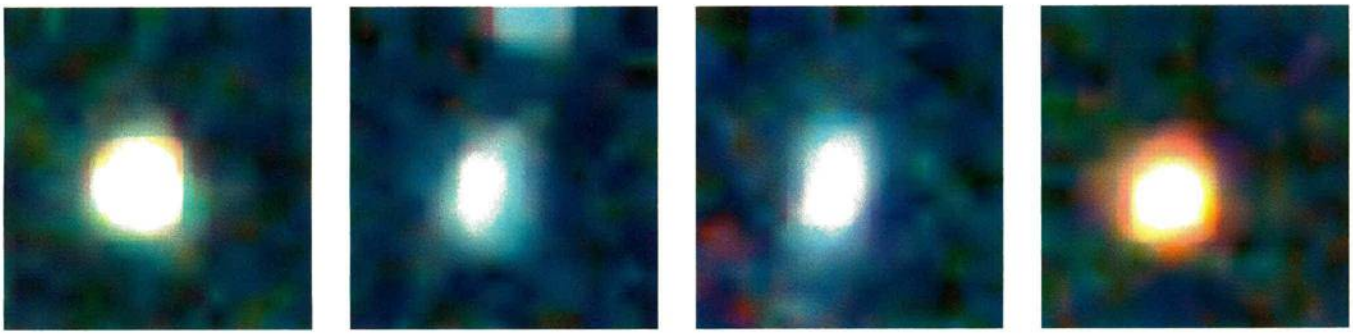
To further confuse things, Leonard Searle and Robert Zinn showed in a 1978 study that the chemistry of star clusters in the Milky Way's halo is too consistent to allow a single, smooth collapse like that envisioned by Eggen, Lynden-Bell, and Sandage. A single, smooth collapse would concentrate the elements cooked in massive stars toward the developing galaxy's center as the gas dropped inward, while a lumpy collapse would blend the different materials widely. Because Searle and Zinn found a uniform distribution of heavy elements, they proposed that the galaxy formed not from a single, smoothly collapsing gas cloud, but from a very lumpy set of clouds already forming stars before they fell together. These lumps might look somewhat like dwarf galaxies.

If lumps continued accreting after they started making stars, the process might last a good deal longer than originally believed. In fact, in a sense, galaxy formation by this process is still going on. In our neighborhood, astronomers still see examples of galaxies merging. When one of the galaxies is much smaller than the other, we tend not to dignify it as a merger, but as cannibalism — the galactic equivalent of a hostile takeover. If Searle and Zinn are correct, the early universe would have looked quite different, with many small galaxies swarming together at various rates instead of huge, full-grown galaxies all coming together at once. This also makes primeval galaxies fainter than we would have expected. They would have fewer of the brightest young stars at any one time, although the process would last longer.

Telescopes as Time Machines

The question for primeval galaxy hunters has become, "Where do you look?" Virtually all astronomers agree that primeval galaxies must exist at high redshifts, extreme distances near the beginning of the observable universe. The light we see from them, then, has traveled since the universe's earliest days. So the work to find primeval galaxies means finding galaxies with the highest redshifts and learning about them by comparing their spectra and structures to those of nearby, familiar galaxies. The problem is that not all extremely faint galaxies are extremely distant. Many intrinsically faint galaxies lie closer to home. How can astronomers tell just which 24th-magnitude galaxy to spend a whole night researching?

Various groups of astronomers have taken different approaches to finding galaxies at high redshifts. One choice is to look at quasars, because they have long held the records for the most distant objects. This year's record has a redshift, z, of 4.95, meaning it lies more than 8 billion light-years distant. Clearly, quasars are intimately related to galaxies. They probably represent the energetic, unstable centers of infant galaxies. But at the highest redshifts, even the Hubble telescope fails to show galaxies surrounding quasars. More creatively, some astronomers have looked at objects directly in front of quasars, partly blocking their light at particular redshifts and introducing "dips" into the quasars' spectrum. Many of the intervening objects appear to be immense hydrogen clouds. Some of these contain carbon, silicon, and magnesium atoms and appear to have faint galaxies associated with them. While yielding only a few objects directly, this technique allows the selection of galaxies based on their gas content, not on how bright they are.



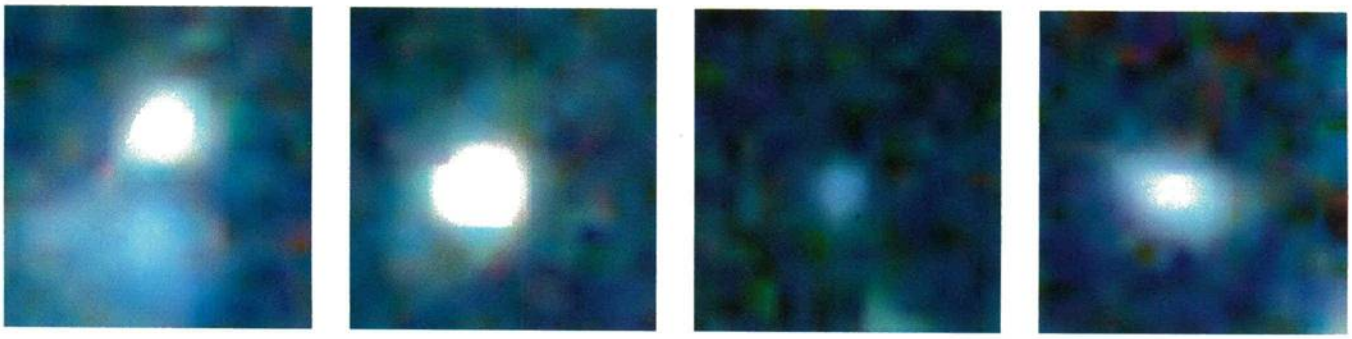
Many radio galaxies are nearly as distant as quasars. In our neighborhood, spectacular double radio sources are associated almost exclusively with very bright galaxies. Thus, if astronomers see a tiny double radio source that matches a very faint object in visible light, the odds are good that the galaxy is in fact very distant and luminous. Radio galaxies from the 1960-vintage Third Cambridge (3C) catalog have redshifts as large as z = 2.5 (7.4 billion light-years), and later surveys which go beyond the bright radio sources have turned up galaxies with redshifts as large as z = 4.25 (8 billion light-years). Going after radio sources provides a good way of finding galaxies distant enough that they must be very young. And some of these have bizarre forms and powerfully glowing clouds of gas which indicate they are unlike anything in our corner of the universe. These are so odd that astronomers must wonder what they can conclude about ordinary galaxies from them. Are they representative of later, normal galaxies, or are they such rare and extreme objects that they tell us only about themselves?

Galaxies by Radio

Several groups have tried to circumvent this problem by looking at weak radio galaxies — those thousands of times less powerful than the high-redshift galaxies found by the 3C survey. These objects can be observed by the Very Large Array radio telescope in New Mexico. The unusual radio emission flags these distant galaxies, making them identifiable, and because they are so numerous the hope is they are likely to have become today's run-of-the-mill galaxies, perhaps after a loud phase of adolescent rebellion. As astronomers had hoped, it proved possible to find many of these galaxies at redshifts above 1, so they could start using them to examine galaxy evolution and, eventually, formation.

An especially interesting target was the galaxy 53W002, which led to spectacular new findings with the Hubble Space Telescope backed by a host of ground-based observations. The radio source, number 2 in the 53rd catalog from the Westerbork Synthesis Radio Telescope in the Netherlands, was found by Rogier Windhorst. At 23rd magnitude, it's faint enough that several years elapsed before Windhorst could get a spectrum showing measurable features, at a redshift z = 2.39 (7.3 billion light-years).

Far and away the highest redshift found for any of his radio sources, the radio source was weak enough to offer a chance to see the properties of the stars in the surrounding galaxy clearly. Windhorst used the 4.4-meter Multiple Mirror Telescope in Arizona and the 5-meter Palomar telescope in California, which suggested that the stars in this galaxy are much younger than we see for nearby radio galaxies. But the structure of the galaxy eluded this work, since all the action takes place in a region not much more than an arcsecond across.



I got to know this galaxy through a chance encounter over a coffee table at the Baltimore meeting of the International Astronomical Union in 1987. A group discussion began by asking how we could compare the spectrum of 53W002, redshifted so strongly that Windhorst and his colleagues had measured only the deep ultraviolet part, with nearby radio galaxies, so we could see how they compared. At the time, this was possible only by using the International Ultraviolet Explorer satellite, which carried an 18-inch telescope and ultraviolet spectrometers in geosynchronous orbit. Our group observed the handful of radio galaxies close enough for measurements with IUE over the next three years, and found that indeed their stellar populations were normal for bright elliptical galaxies with or without radio sources. However, something rather different popped up in 53W002 — evidence of light from large numbers of hot, young stars. Was this the trail of galaxy formation, of the initial widespread epoch of starbirth?

Building Blocks at Last?

Clearly, more work needed to be done. Did 53W002 look like today's elliptical galaxies, or did it have some other strange form? The Hubble Space Telescope would help us find out. Our group was able to show that 53W002 is very close to the form of an elliptical galaxy, with its light falling off around the edges in just the way it does for nearby ellipticals, and not like spirals or irregular galaxies. The comparison was obvious. We had an elliptical galaxy of the same size and form as nearby ones such as M87 in Virgo, but loaded with much younger stars. Our group speculated at this point that we might be seeing part of a single collapse as hypothesized by Eggen, Lynden-Bell, and Sandage — stars had been forming, were still forming, in the telltale elliptical framework, but the spectrum, along with millimeter-wave measurements, showed that lots of gas was still present.

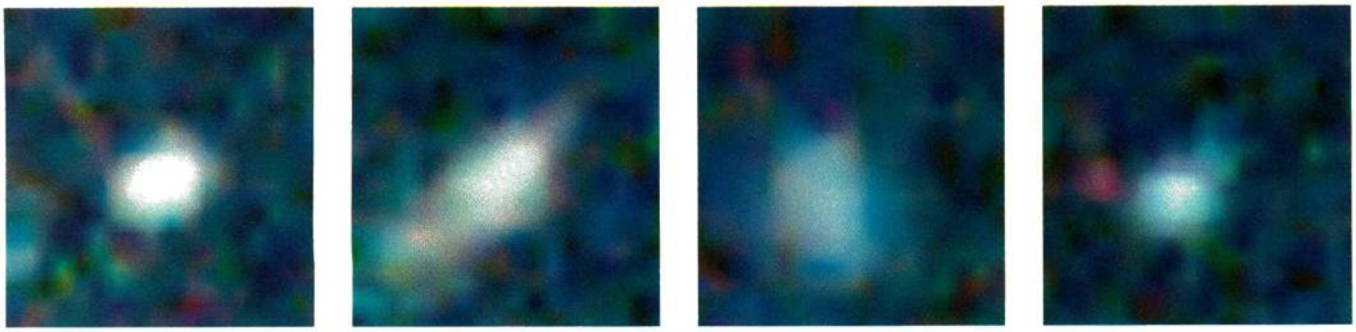
More detailed images could naturally tell us more. Because orbital periods increase with distance from a galaxy's center, the distance at which the stars have settled into a smooth, symmetric distribution can act as a crude clock. Images taken with several filters could show whether the stars started forming on the inside, outside, in patches, or everywhere at once. Our group obtained Hubble images that extended our earlier conclusions, showing a blue cloud associated with the radio source, probably caused by light from the nucleus reflecting off dust. It also suggested that the youngest, bluest stars were in the center, indicating a smooth collapse.

The most interesting result from these data, though, hinged on serendipity. Windhorst's continued observations with the Multiple Mirror Telescope included measuring spectra of brighter galaxies in the field for statistical purposes. Sam Pascarelle, a doctoral student, did this one night and followed the field closer to the horizon than is desirable. At this low elevation, atmospheric refraction moved another faint object into one of the several small spectrograph apertures, and Pascarelle immediately saw that it showed the same redshift as 53W002. Subsequent Hubble observations allowed us to capture 17 objects at the same distance. Are these the long-sought protogalaxies?

If they are, we're seeing a piece-by-piece buildup of several galaxies. These objects have the right structures to be ellipticals, but are much too small, taxing the ability of even Hubble's camera to trace them. They have typical radii of only about 3,000 light-years, smaller than we would expect the progenitors of galaxies in clusters to be. If this group represents normal galaxies at this stage in the universe, these objects must somehow grow — a lot — to become today's bigger galaxies.

A State of the Galaxies Report

A new study by Lennox Cowie of the University of Hawaii and colleagues, using the Keck telescope, provides food for thought that may resolve some otherwise puzzling facts. This group finds evidence that the time needed to form galaxies (and most of their stars) corresponds to the brightness of a galaxy. The most massive galaxies may have finished the process by the time the universe



was half its current age, and progressively smaller galaxies are continuing the process.

But astronomers don't yet know the ultimate answers. Beyond the cluster our group found, similar searches are turning up more possible primeval galaxies. Caltech's Charles Steidel and his coworkers note that any substantial amount of interstellar hydrogen in a galaxy will chop out virtually all its light at wavelengths immediately short of 912 angstroms, deep in the ultraviolet. Thus, a galaxy which is easy to see at red wavelengths but disappears going into the blue region is likely to be very distant, so that its deep-ultraviolet light shows up in the visible range. Steidel and coworkers have found galaxies at redshifts of up to $z = 3.4$ (7.8 billion light-years) in this way. Two more groups have searched the Hubble Deep Field data for even higher-redshift galaxies, with cutoffs redshifted into the near-infrared. Several such objects were found, but they are so faint that further spectroscopic confirmation is beyond present capabilities.

Such searches may answer some of the big questions about how galaxies formed: Theories have predicted that galaxies should form big to small or small to big, depending on what gravitational and radiation processes were most important in the early universe.

Which is Correct?

Even more crucial, and difficult to pin down, is the role of dark matter. Ample evidence exists that galaxies contain an enormous amount of unseen material, detected only by gravitational influence, and there must be so much dark matter that its gravity completely dominated galaxy formation — all that we can see went along for the ride. The precise nature of dark matter also controls just when galaxies started forming, and what the seeds were. The dark matter holds the key, and much of the mystery, then, to galaxy formation.

How can we penetrate the desert between the microwave background, when the universe was less than a million years old, and the first quasars and galaxies astronomers can see, at ages of several billion years? The answer will probably lie in the infrared and submillimeter regions of the spectrum, if for no other reason than the redshift from the expanding universe. What astronomers want to see here is light now shifted so far to the red that there is basically nothing to see in visible light.

A major step should come with the installation of Hubble's first true infrared instrument, NICMOS. In principle, NICMOS will detect galaxies at redshifts almost 2.5 times greater than the current Hubble camera. Furthermore, it will see in unparalleled detail what started out as visible light before it was redshifted, so astronomers can compare near and distant objects.

Impatient astronomers are already dreaming of the next generation of telescopes. One advisory panel to NASA has called for an orbiting telescope with aperture about 4 meters optimized for work deep into the infrared, and cooled for greater sensitivity. New technologies will be required to produce a system that stays cold enough to avoid seeing its own thermal infrared radiation, and can be operated reliably far enough away from Earth to avoid the planet's own infrared glow. Conveniently, this instrument represents the next step in studying the formation and evolution of both galaxies and planetary systems.

Seeing galaxies form and evolve is most important, perhaps, not for the details, but as the ultimate signal that ours is indeed an evolving universe. Few can be unmoved by the spectacle of the deep universe as unveiled in these deep images. Many more of them will be forthcoming from the electronic eyes of Hubble. The goal, though, is to do intellectually what these pictures lead us to aesthetically — to appreciate the span of space and time that led us here. ■

University of Alabama astronomer William Keel researched his dissertation on the nuclei of galaxies at Lick Observatory, followed by postdoctoral work at Kitt Peak National Observatory and Leiden Observatory. Check his extragalactic activities at http://www.astr.ua.edu/keel.

"Advertising in ASTRONOMY® *is a great investment."*

Lucy Albert
Virgo Astronomics
608 Falconbridge Dr.
Suite 46
Joppa, Maryland 21085
410-679-7055

▼

Lucy Albert got the idea to open an astronomy-based business at a star party. She now owns Virgo Astronomics which sells binocular mounts and other astronomy accessories to amateur astronomers nationwide. "My product first appeared in ASTRONOMY's new Product Showcase and I got several responses," said Lucy. "This proved to me that the magazine was widely read."

Since its first showcase appearance, Virgo Astronomics can be found every month in ASTRONOMY. Lucy believes that in order to stay credible with her target market she needs to keep advertising. "I know I have to maintain my advertising every month and I'm here to stay. ASTRONOMY is the best way to reach the large amateur astronomy market with the least amount of money. I realize advertising takes time and money but it's well worth the investment."

For information on how to advertise in ASTRONOMY call toll free:
1-888-237-4572
Outside the U.S. or Canada call 414-796-8776.

Advertising Sales Manager,
Dan Koehler, ext. 628

Advertising Sales Representative,
Colby Waller, ext. 636

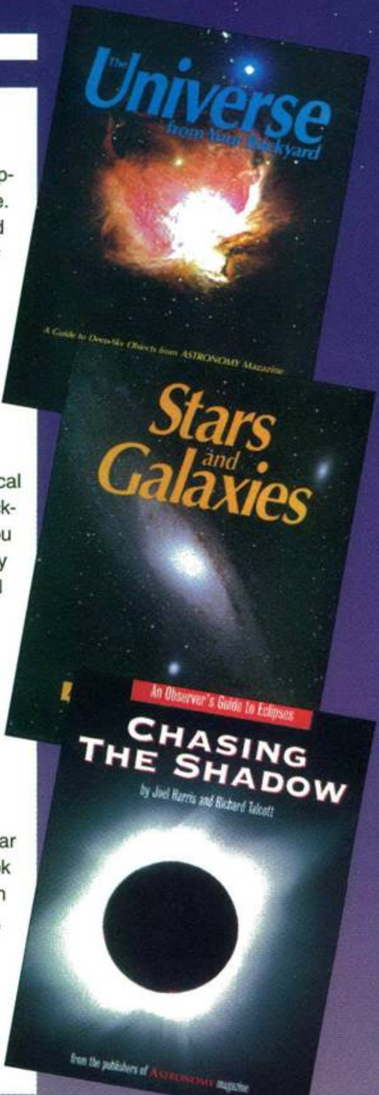
Classified Advertising Representative,
Mardi Arsta, ext. 538

Blue Sky Pages, Pam Hagan, ext. 487

0247-9707AAad

OBSERVER'S GUIDES

from ASTRONOMY Magazine


The Universe from Your Backyard
A Guide to Deep-Sky Objects from ASTRONOMY Magazine
Stars and Galaxies
An Observer's Guide to Eclipses
CHASING THE SHADOW
by Joel Harris and Richard Talcott
from the publishers of ASTRONOMY magazine

The Universe from Your Backyard

Find and enjoy over 600 of the finest deep-sky objects with a backyard telescope. Breathtaking color photos and detailed maps will guide you on a spectacular tour of 46 constellations. 8¼ x 10¾; 112 pgs.; 131 b&w and 90 color photos; 116 illus.; hardcover.

#18037 ....$29.95

Stars and Galaxies: ASTRONOMY's Guide to Exploring the Cosmos

Learn about the greatest astronomical objects visible using binoculars or backyard telescopes. This book shows you how to locate and observe 344 deep-sky objects, and includes tables, maps, and diagrams to help understand them. 8½ x 11; 200 pgs.; 129 b&w and 110 color photos; 98 illus.; 34 charts; hardcover.

#18536 ....$29.95

Chasing the Shadow: An Observer's Guide to Eclipses

Your complete planning guide to solar eclipse observation! This how-to book includes travel programs, choosing an observing site, observation techniques, equipment, still and video photography, and safety precautions. 7⅜ x 9⅜; 160 pgs.; 48 photos; 14 maps; softcover.

#18542 ....$18.95

Look for these books at your favorite bookstore or call toll free

1-800-446-5489

Monday–Friday 8:30am–5:00pm Central Time. Please have your credit card ready. Fax 414-796-1615. Outside the U.S. and Canada call 414-796-8776.

Or send your order to Kalmbach Publishing Co., Dept. A1301, 21027 Crossroads Circle, P. O. Box 986, Waukesha, WI 53187-0986. Include for postage and handling: U.S. add $3.00 for 4th class (or $4.50 UPS in the continental U.S. only). Canada add $5.00, other foreign add $10.00. For delivery in Wisconsin add 5% sales tax to total; Virginia add 4.5% sales tax to total; Michigan add 6% sales tax to total. For delivery in Canada add 7% GST to total. Payable in U.S. funds. Prices and availability subject to change.

KALMBACH BOOKS www.kalmbach.com

A1301

0243-9707APad

www.shutan.com

Courteous Service • Low Prices • Large Selection

Meade Instruments offers the most complete selection of telescopes & accessories for the astronomer!

7", 8" & 10" LX50:
- Heavy-duty LX200 fork mount!
- 4-speed dual-axis quartz drive!
- Built-in power source! (4-AA)
- Built-in DEC motor!

See Meade ad or call for details on these scopes!

Meade LX200
7", 8", 10", 12"

Call ***Toll-Free*** *for up-to-date Telescope prices!*

2-Inch Focuser & DC Drive!

Meade Equatorial Starfinders:
6" f:8
8" f:6
10" f:4.5
16" f:4.5

Authorized
APD
Dealer!
STARFINDER
MEADE

2-Inch Focuser!

Meade Dobsonian Starfinders:
6" f:8
8" f:6
10" f:4.5
12.5" f:4.8
16" f:4.5

New Low Prices on Meade 4000 Eyepieces & CCD Cameras!

Series 3000 Eyepieces *Made in Japan!*	
Plossl 5, 6.7, 9.5, 16, or 25mm	$50
40mm Plossl	80
Series 4000 Eyepieces *Made in Japan!*	
Super Plossl 6.4, 9.7, 12.4, 15, 20, 26	80
SP32 or 40mm	100
SP56mm	200
Super Wide 13.8	140
Super Wide 18	150
Super Wide 24.5	180
Super Wide 32	240
Super Wide 40	300
Ultra Wide 4.7	170
Ultra Wide 6.7	200
Ultra Wide 8.8	240
Ultra Wide 14	300

Barlow Lenses:	
#122 2x 1.25"	$48
#126 2x 1.25"	48
#140 2x 1.25"	80
ETX Accy's:	
Soft case	40
Hard case 15x22"	
Solar filter-glass	55
Dew shield	25
Adjust. field tripod	149
T-adapter #64	30
Prism 45° #932	43
Starfinder Accy's:	
Accy shelf-EQ	38
Dust cap 6" or 8"	21
Dust cap 10"	27
Dust cap 12.5/16"	call
2045D Accy's:	
Barlow 126 2x	48
Hard case	80
Tripod & wedge	275

Pictor 416XT
w/$800 Accy's
$1699.00

Misc. Meade	
AC adapt-18v	$85
AC adapt-Pictor	call
Accy shelf f/SCT	25
Accy case 50	67
Car adapt 18 volt	85
Case 7/8/10/12"	call
Diagonal 929 2"	99
Epoch 2000 Disk	149
Epoch 2000 CD	179
EP holder 1.25"	25
EP size converter	21
Focuser 70 1.25"	59
Finder 544-8x50	70
Finder 545-8x50	70
Finder 634-6x30	50

Finder brkt-8x50	$25
Filter set of 4	50
Filter set of 8	100
Filter set of 12	150
Filter ND96 1.25"	18
Focal reducer f:6.3	130
Illum 12mm w/cord	80
Illum 12mm-wless	100
Illum 9mm w/cord	130
Illum 9mm-wless	150
Lenshood 7/8"	114
Lenshood 10"	124
Lenshood 12"	174
Magellan-I & II	call
Nebula 908B	80
Nebula 908N	90
Nebula 911B	100
Nebula 911N	120
Off-axis guider	80
Pictor 201XT	399
Pictor 208XT	499
Pictor 216XT	699

Piggy bracket 7/8"	$34
Piggy bracket 10"	34
Piggy bracket 12"	49
Prism 1.25" 90°	42
Prism .96-1.25"	30
Prism .96" 45°	43
Prism 1.25" 45°	43
Skylight/seal	48
Star charts	17
Tele extender	30
Tele ext-variable	40
T-adapt: SCT	27
T-adapt: vari-proj	40
T-adapt: 1.25"	30
T-rings	16
Vari pol 905	50
Weight set 7"	92
Weight set 8"	92
Weight set 10"	99
Weight set 12"	109
Wedge 8"	134
Wedge Super	395

Book, Books, and More Books!

Astrophotography for the Amateur	M. Covington, 7x10", 168 pgs.	$20
Bright Star Atlas	Wil Tirion, 9x12", 36 pgs.	11
Cambridge Atlas of Astronomy	10x15", 472 pgs.	90
Chasing the Shadow	J. Harris, 7x9", 160 pgs.	19
City Astronomy	R. Scagell, 6x9", 176 pgs.	19
Comet Hale-Bopp	Alan Hale, 6x9", 162 pgs.	13
Deep-Sky Introduction	6x9", 272 pgs.	25
Messier Album	J. Mallas, 6x9", 248 pgs.	22
Monthly Star Charts	Sky&Tel Mag., 11x14", 68 pgs.	25
Norton's 2000.0	9x11", 179 pgs.	50
Phillips Color Star Atlas	J. Cox, 11x15", 40 pgs.	20
Planisphere 10" 30 to 50 degree		10
Sky Catalog 2000.0 vol.1	A. Hirshfeld, 9x12", 704 pgs.	40
Sky Atlas 2000.0 Deluxe	Wil Tirion, 11x16", 26 charts	45
Star Hopping	A. MacRobert, 9x11", 160 pgs.	23
Summer Stargazing	T. Dickenson, 8x11", 64 pgs.	19
Telescopes & Techniques	6x9", 204 pgs.	25
Turn Left at Orion	G. Consolmagno, 8x11", 205 pgs.	25
The Moon	Astronomy Mag., 8x11", 80 pgs.	12
Urban Astronomer	7x10", 224 pgs.	17
Uranometria 2000.0 vol.1	Wil Tirion, 10x12", 260 pgs.	40

WE CARRY 70 DIFFERENT BINOCULARS!
Celestron • Nikon • Bausch & Lomb • Swarovski • Leica • Pentax

1000 Oaks

Solar Filters!

Precision polished Type2 **glass,** triple-coated in machined aluminum cell. Image is yellow-orange—no need for secondary filtering!

ETX	$55
5" aperture	65
6" aperture	70
7" aperture	70
8" aperture	90
10" aperture	100
12" aperture	125

Kendrick

Dew Removers

Centered around the controller that has a 12v cigarette plug and is fused and reverse polarity protected. Has four (4) jacks to plug your heaters into. Power output can be varied from 40% to 100%.

12v Controller	$65
Telrad heater	23
1.25"/2" heater	35
3" heater (ETX)	40
5" heater	45
7/8" heater	50
10"/11" heater	60
12" heater	70

Dew shields in stock!

JMI

Motorized Zero-Image Shift Focusers!

For ALL 8", 10", 12" Meade or Celestron Schmidt-Cassegrains!

2" NGF-S	$254

Eliminates the wiggles!

NGF3 Mini 1.25"	94
NGF3 2-inch	144
Leveling wheely bar for Meade 8" or 10" Schmidt-Cass	144
For 12" SCT	189
Keypad holder for LX200's	34

Celestron

7x50 Ultima	$250
10x50 Ultima	250
8x56 Ultima	280
9x63 Ultima	340
20x80 Deluxe	450

Lumicon Filters!
Deep Sky • O-III
H-Beta • UHC
Now In Stock!

Celestron

C5+ **Call**

C5 tripod	$239
C5 dec motor	95
Celestar 8	call
Celestar 8 Deluxe	call
First 80 EQ/WA	call
C4.5	call
F:6.3 reducer	127
Ultima 2x 1.25"	75

Telrad

$42

LX200
Easy-Mount

11.5" x 20"
$95

- Easy 1-person mounting
- Bumper-type registration
- CNC machined
- 1/4" AG anodized alum.
- Holds 12 eyepieces!
- Holds keypad securely

TeleVue

Genesis SDF	call
Pronto	call
Ranger	call
Ranger Brass	call
Quick Point	40
Starbeam-T	179
2" 90° diagonal	184
1.25" 90° diag	75
Eyepiece proj	69
Ext tube 2 or 3"	33
Bino viewer	call
Gibraltar mt	459
Paracorr 2"	230
Plossl-50°	
8, 11, or 15	82
20 or 25mm	94
10.5, or 13	70
32 or 40mm	114
55mm	229

TeleVue

Panoptic-68°	
15mm	$209
19mm New!	239
22mm	279
27mm	329
35mm	366
Bar. interface	90
Nagler-82°	
4.8mm	174
7mm	222
9mm	239
12mm Type2	288
13mm	309
16mm Type2	309
20mm Type2	389
Barlows	
1.25" 2x or 3x	105
Big Barlow 2"	169

Our 79th Year!

Call for our FREE 80-Page Discount Buying Guide! Check or charge card— **ALWAYS** the same low price! Order by **NOON** for same-day shipment. C.O.D. available, inquire. We ship most accessory orders up to 5 lbs. for just **$6.50** via UPS Ground or **$22** 2-Day Air to most addresses in Continental U.S. **When in Chicago, visit our 3500 square foot showroom!** Shutan is family owned **AND** operated since 1918! *All prices subject to change.*

SHUTAN
camera & video

We welcome bids & PO's from schools!

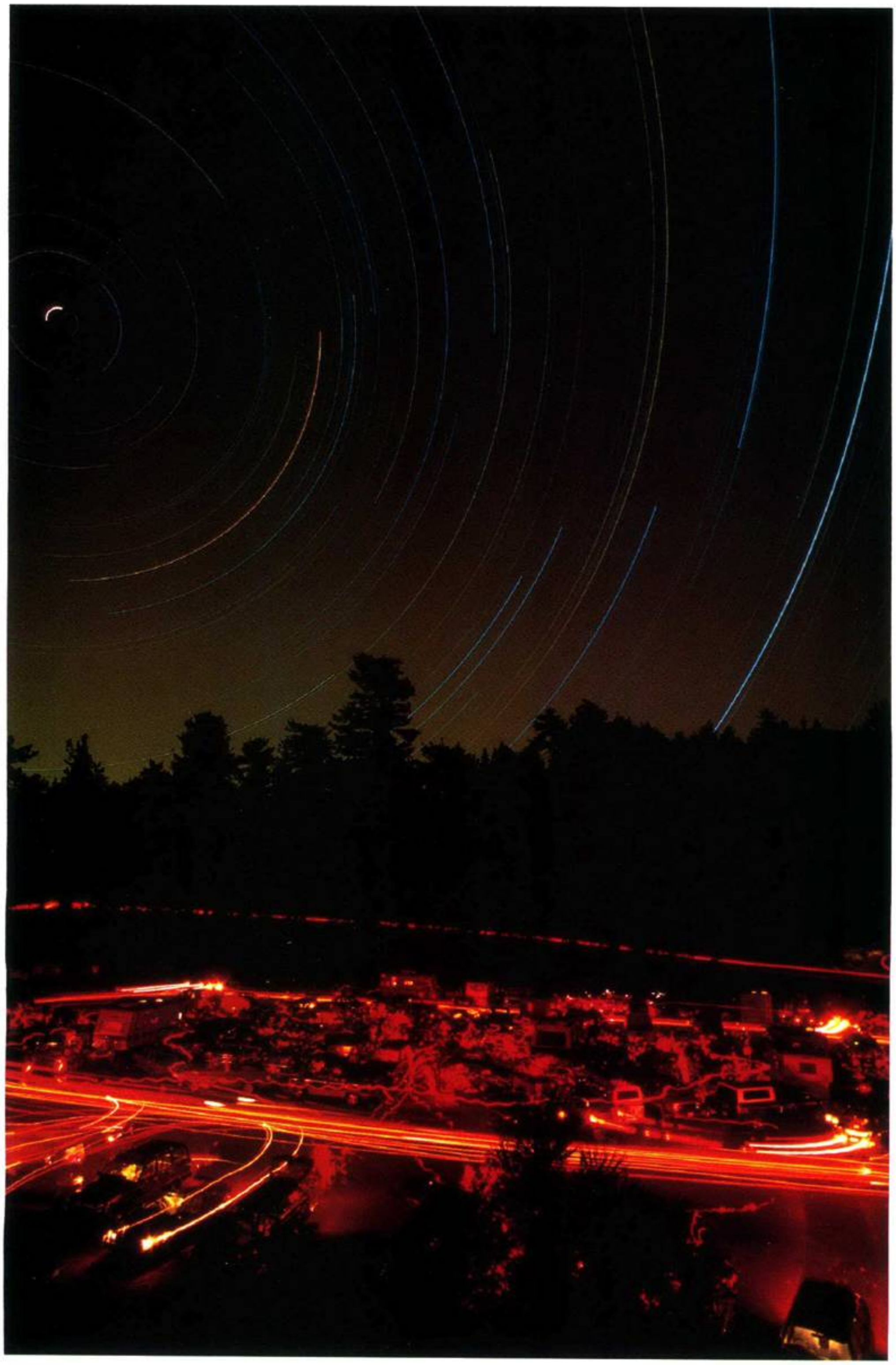
Toll-Free 800-621-2248
Illinois Residents 312-332-2000
312 W. Randolph • Chicago • 60606

DISCOVER MasterCard VISA AMERICAN EXPRESS
No Surcharge!

THE SKY SHOW

Find every known planet in our solar system before the midnight hour, then relax and take in the sights our home galaxy, the Milky Way, has to offer.

By Martin Ratcliffe and Alister Ling



Tony and Daphne Hallas

July offers ready-made evenings for enjoying the summer sky. Many night observers and photographers band together to hold impromptu star parties like this one in California. This time exposure shows both observers and the sky on the move.

▶ All nine known planets have a major role in the drama of the sky during these short July nights. The first one's a gift — the planet we are observing from, Earth. Earth, perhaps in honor of the 221st birthday of the U.S., on July 4th reaches aphelion, its farthest point from the sun. On that day we'll be 94,516,000 miles from our home star, just 3% farther than perihelion distance in January.

Planets two and three on our list of nine, **Mercury** and **Venus**, skirt one another during July after the sun sets. Both hug the western horizon all month and remain deep in evening twilight. Mercury, the closest planet to our sun, will be hardest to see. Look for it 30 to 45 minutes after sunset low in the west-northwest.

This elusive "star" is closing in on a maximum evening elongation in early August. But late July is still the best time for North American observers to catch this planet, as it is brighter than it will be next month.

As evening apparitions such as July's unfold, the percentage of Mercury's *illuminated* face as seen from Earth shrinks fast. This causes the planet's apparent brightness to decrease as well. By the end of July,

JULY 1997

1 **Asteroid Irene is at opposition, 5 a.m. EDT**

2 **The moon passes 0.6° north of Aldebaran, 1 a.m. EDT**

4 **New moon is at 2:40 p.m. EDT**
Earth is at aphelion (94.5 million miles from the sun), 3 p.m. EDT
Mercury passes 5° south of Pollux, midnight EDT

6 **The moon passes 5° south of Venus, 10 p.m. EDT (page 72)**

9 **The moon is at apogee (251,621 miles from Earth), 6:51 p.m. EDT**

10 **Asteroid Herculina is at opposition, 3 p.m. EDT**

11 **The moon passes 1.8° north of Mars, 9 p.m. EDT**

12 **First quarter moon is at 5:44 p.m. EDT**

19 **Asteroid Pallas is at opposition, 6 a.m. EDT (page 75)**
Full moon is at 11:20 p.m. EDT

21 **Neptune is at opposition, 3 a.m. EDT (page 73)**
The moon passes 4° north of Jupiter, 1 p.m. EDT
The moon is at perigee (224,676 miles from Earth), 7:01 p.m. EDT

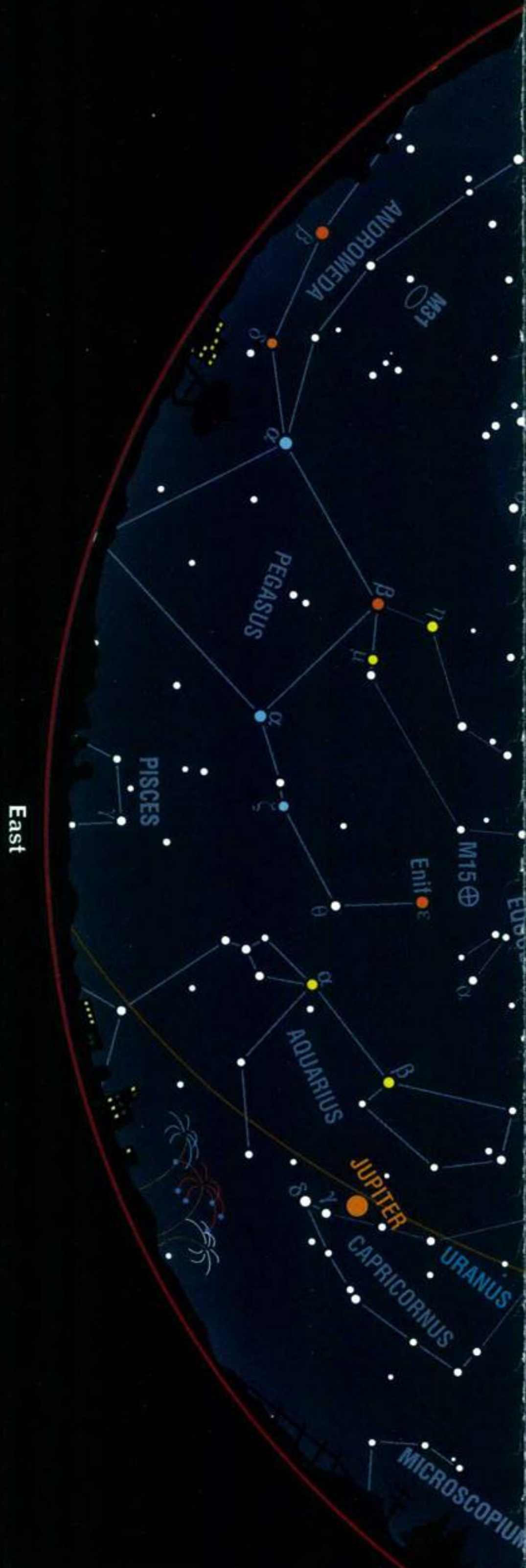
22 **Venus passes 1.2° north of Regulus, 9 p.m. EDT**

25 **The moon passes 0.02° south of Saturn, 3 p.m. EDT**

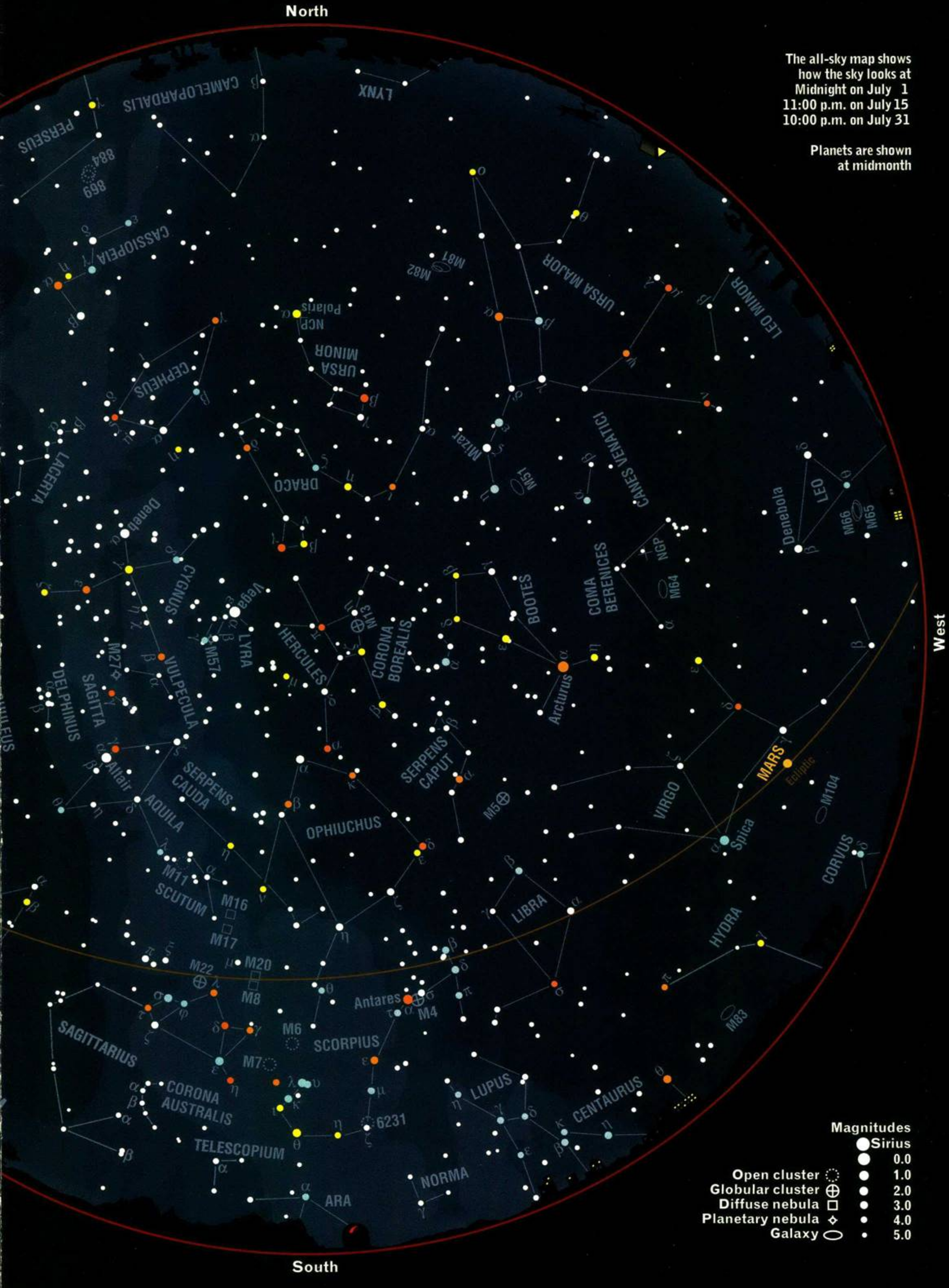
26 **Last quarter moon is at 2:28 p.m. EDT**
Mercury passes 0.5° south of Regulus, 8 p.m. EDT

29 **The moon passes 0.4° north of Aldebaran, 7 a.m. EDT**
Uranus is at opposition, 3 p.m. EDT (page 73)

Sun.	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		



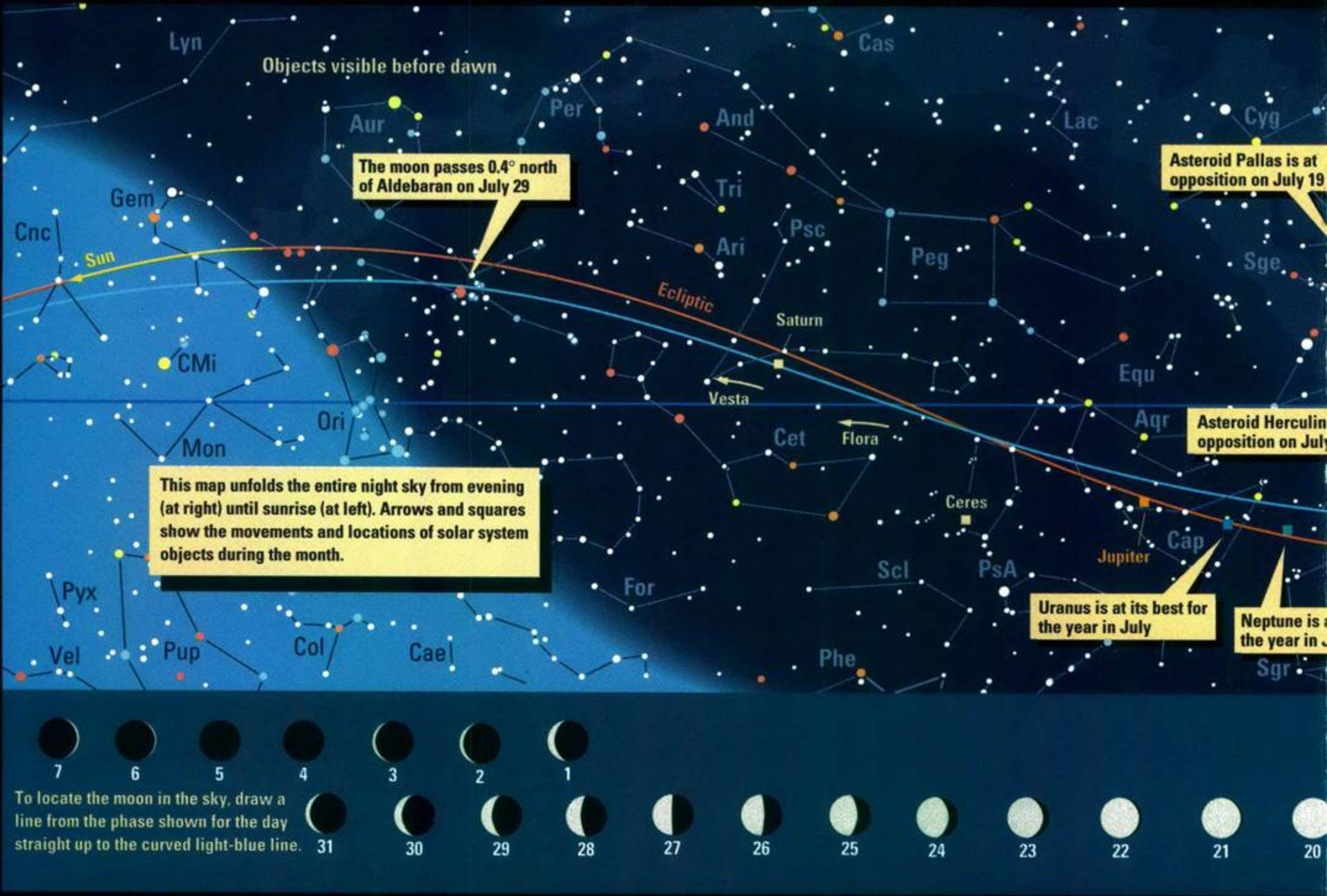
This map portrays the sky at times shown in the upper right corner of the page. Located just outside the map are the four directions: north, south, east, and west. To find stars above your horizon, hold the map overhead and orient it so a direction label matches the direction you're facing. The stars above the map's horizon now match what's in the sky.


North
South
West
PERSEUS
884
869
CAMELOPARDALIS
LYNX
CASSIOPEIA
M81
M82
URSA MAJOR
LEO MINOR
Polaris
NCP
URSA MINOR
CEPHEUS
DRACO
Mizar
M51
CANES VENATICI
LACERTA
Deneb
CYGNUS
LEO
Denebola
M66
M65
NGP
COMA BERENICES
M64
BOOTES
Vega
LYRA
M57
M13
HERCULES
CORONA BOREALIS
Arcturus
M27
VULPECULA
DELPHINUS
SAGITTA
Altair
SERPENS CAUDA
SERPENS CAPUT
AQUILA
M5
OPHIUCHUS
VIRGO
MARS
Ecliptic
M104
Spica
CORVUS
M11
SCUTUM
M16
M17
LIBRA
HYDRA
M22
M20
M8
Antares
M4
M83
SAGITTARIUS
M6
SCORPIUS
M7
CORONA AUSTRALIS
LUPUS
CENTAURUS
6231
TELESCOPIUM
NORMA
ARA
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
Open cluster
Globular cluster
Diffuse nebula
Planetary nebula
Galaxy

The all-sky map shows
how the sky looks at
Midnight on July 1
11:00 p.m. on July 15
10:00 p.m. on July 31

Planets are shown
at midmonth

THE PATH OF THE PLANETS


Lyn
Cas
Per
Aur
And
Lac
Cyg
Tri
Gem
Cnc
Sun
Psc
Ari
Peg
Sge
Ecliptic
Saturn
CMi
Vesta
Equ
Ori
Mon
Cet
Flora
Aqr
Ceres
Cap
Jupiter
Pyx
For
Scl
PsA
Vel
Pup
Col
Cae
Phe
Sgr
7
6
5
4
3
2
1
31
30
29
28
27
26
25
24
23
22
21
20

Objects visible before dawn

The moon passes 0.4° north of Aldebaran on July 29

Asteroid Pallas is at opposition on July 19

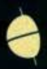
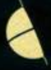
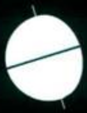
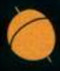
Asteroid Herculin opposition on July

This map unfolds the entire night sky from evening (at right) until sunrise (at left). Arrows and squares show the movements and locations of solar system objects during the month.

Uranus is at its best for the year in July

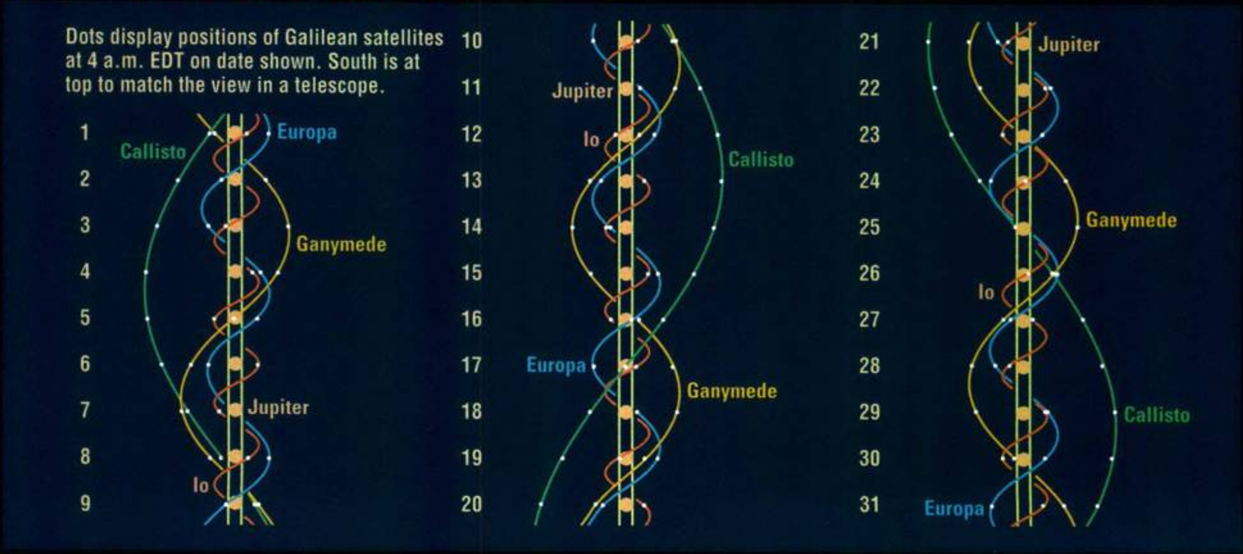
Neptune is a the year in J

To locate the moon in the sky, draw a line from the phase shown for the day straight up to the curved light-blue line.

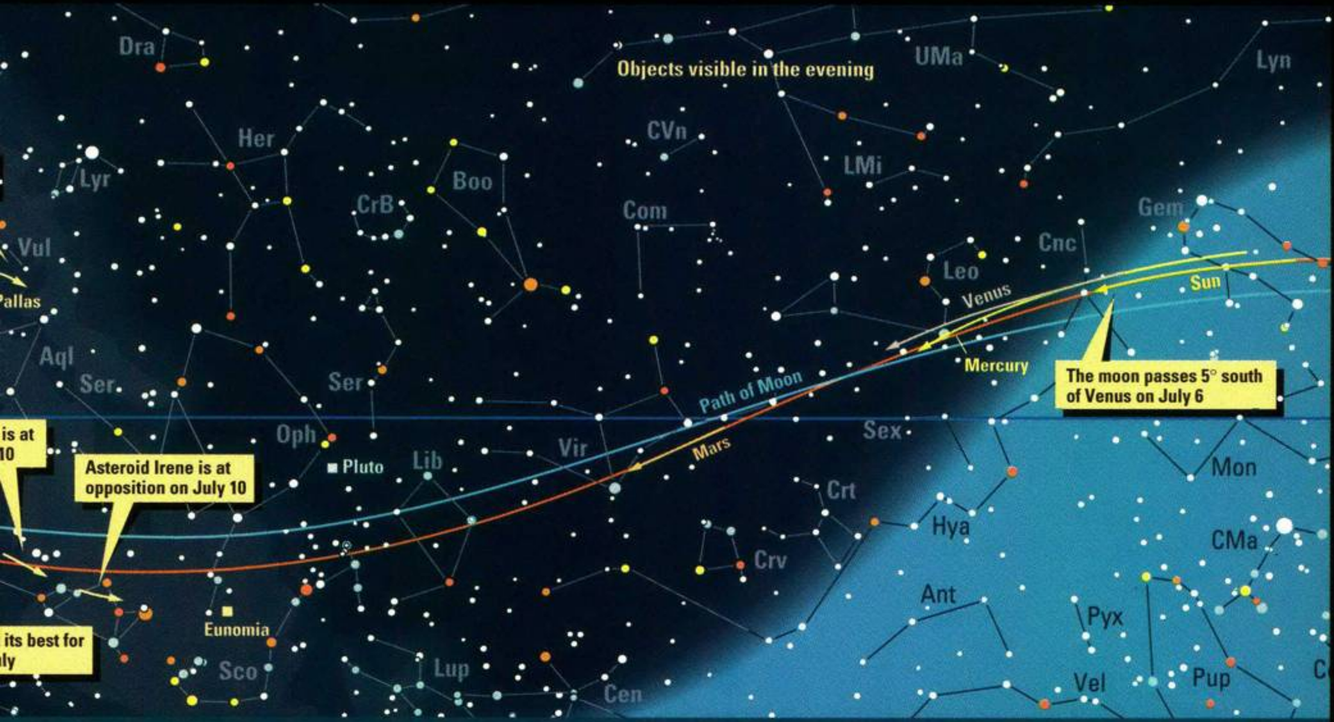





PLANETS	MERCURY	MERCURY	VENUS	MARS	JUPITER
Date	July 15	July 31	July 15	July 15	July 15
Magnitude	−0.4	0.3	−3.9	0.7	−2.8
Angular Size	5.7"	7.2"	11.5"	6.9"	47.5"
Illumination	76%	54%	88%	88%	100%
Distance (AU) from Earth	1.170	0.940	1.455	1.352	4.148
Distance (AU) from Sun	0.403	0.462	0.720	1.543	5.071
Right Ascension (2000.0)	9h00.3m	10h25.6m	9h30.7m	12h45.9m	21h31.2m
Declination (2000.0)	18°34'	9°04'	16°27'	−5°04'	−15°38'

JUPITER'S MOONS



Dots display positions of Galilean satellites at 4 a.m. EDT on date shown. South is at top to match the view in a telescope.

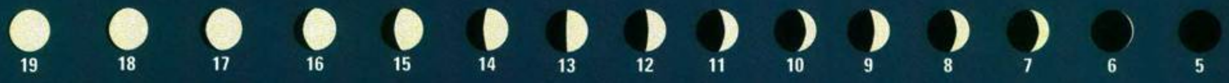

Dra
Objects visible in the evening
UMa
Lyn
Her
CVn
LMi
Lyr
Boo
CrB
Com
Gem
Vul
Cnc
Leo
Sun
Venus
Pallas
Mercury
Aql
Ser
Ser
Path of Moon
Sex
Oph
Mars
Vir
Mon
Pluto
Lib
Crt
Hya
CMa
Crv
Eunomia
Ant
Pyx
Sco
Lup
Cen
Vel
Pup
C

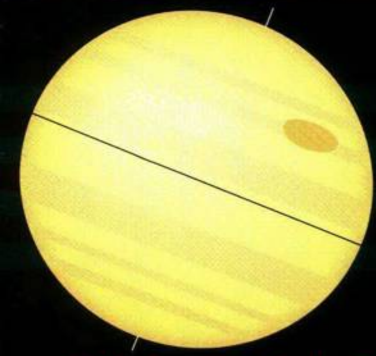
The moon passes 5° south of Venus on July 6

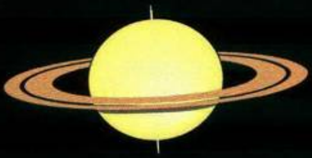
is at
10

Asteroid Irene is at opposition on July 10

its best for
ly

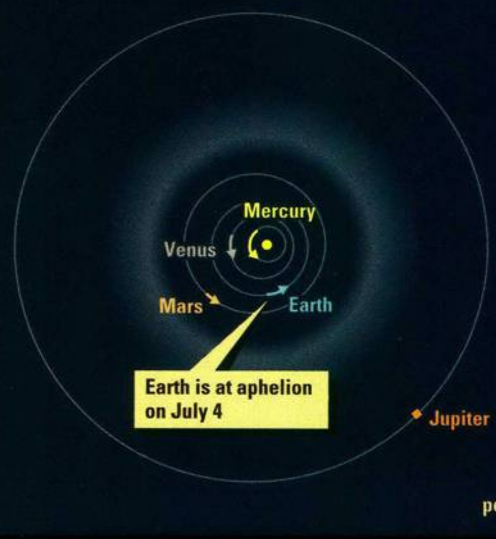

19
18
17
16
15
14
13
12
11
10
9
8
7
6
5



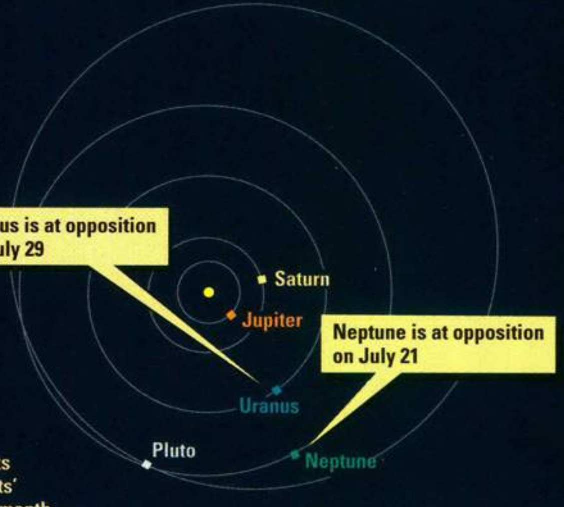


SATURN	URANUS	NEPTUNE	PLUTO
July 15	July 15	July 15	July 15
0.5	5.7	7.8	13.7
17.8"	3.7"	2.3"	0.1"
100%	100%	100%	100%
9.316	18.838	29.140	29.336
9.415	19.823	30.150	29.990
1h18.1m	20h39.5m	20h03.2m	16h14.0m
5°34'	–19°04'	–20°00'	–8°16'

THE PLANETS IN THEIR ORBITS


Mercury
Venus
Mars
Earth
Jupiter

Earth is at aphelion on July 4


Saturn
Jupiter
Uranus
Pluto
Neptune

Uranus is at opposition on July 29

Neptune is at opposition on July 21

Arrows and dots represent planets' positions during the month.

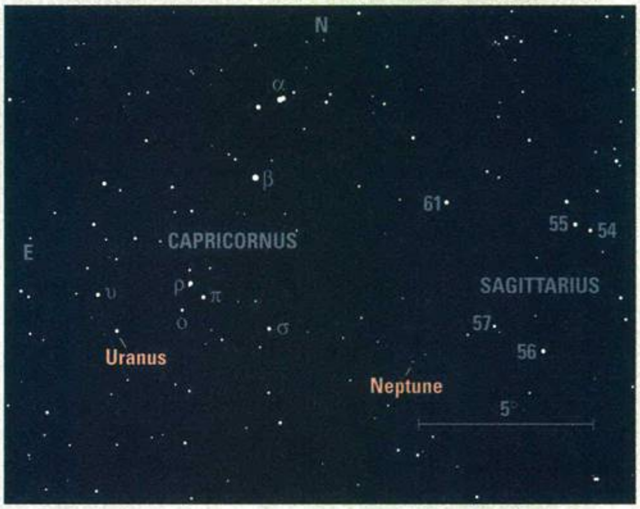
FIRST VIEWS: Uranus and Neptune Reach Opposition

Hubble photo of Neptune, 1994

NASA/STScI

Hubble photo of Uranus, 1995

NASA/STScI



The gas-giant planets Uranus and Neptune are often avoided like the plague by beginning observers because they don't stand out like the brighter, closer planets. But with surprisingly little effort, these two outer planets are within reach of anyone armed with a pair of binoculars, even from the city.

Uranus's green color is a dead giveaway; the planet simply doesn't look like an ordinary star. At magnitude 5.7, it's a snap to find once you know where to look. By midnight, Uranus lies due south in Capricornus.

Start your search by finding the beautiful binocular double star Alpha (α) Capricorni, also called "Algiedi" after an ancient Arabic phrase meaning "the goat." Slip a little less than 6° southeast, past Beta (β), where you'll find Rho (ρ), Pi (π), and Omicron (ο). To the lower left of this grouping lies a green "star": Uranus.

To land Neptune, star hop your way west with binoculars from Uranus. At magnitude 7.8, bluish Neptune will be tougher to identify than Uranus. Slowly make your way to the correct area while comparing the star patterns in your binoculars with what's on the accompanying chart. Neptune should be a "star" that lies in the planet's predicted position. Confirm your find by returning to the star field in a couple of days. The one star that's moved is Neptune.

Mercury's disk will be only half-illuminated, dropping the planet's brightness from magnitude –0.4 at mid month to magnitude 0.3 by the end of July.

Don't confuse Mercury with the star Regulus on July 26, when the tiny planet moves to within half a degree, or a single moon-width, of the magnitude-1.4 star. On the next night, watch as Mercury and the other inferior planet, Venus, lie just 4.5° apart. (Inferior planets Mercury and Venus orbit closer to the sun than Earth.)

Venus is much easier to pick out of evening twilight. It outshines Mercury by a full four magnitudes at –3.9, a dazzling white jewel in an azure evening sky. As Venus's elongation from the sun increases, the planet also heads south on the celestial sphere. The combined effect "locks" Venus into a set altitude above the horizon after sunset. Stars will slip behind Venus on a continual march into evening glare as the planet appears to stay put. Watch for this as Regulus glides just over a degree south of Venus on the evenings of July 22, 23, and 24.

As Venus sets in the west-northwest and the sky darkens, **Mars** beckons in the south. Currently lying in Virgo, the Red Planet fades to magnitude 0.8 by the end of the month while its diameter shrinks to half of what it was at opposition, a mere 6". However small this is, the remnants of the north polar ice cap should look like a bright, white spot through even a moderate-sized telescope.

Mars's motion among the stars brings it to within a few degrees of Spica by the end of July. The pair makes for a beautiful contrast of colors, a diamond and ruby, as they pass side-by-side. This month should also see us witness the landing of NASA's Mars Pathfinder spacecraft. If it's successful, the July 4 touchdown will mark a return to the Red Planet's surface after a 21-year hiatus.

As the sky's canopy of stars turns, the constellations of Leo and Virgo set by late evening. Brilliant Arcturus, in Bootes the Herdsman, hovers very high over the western horizon, matching Mars's color but now outshining the fading Red Planet.

By the midnight hour the Summer Triangle is climbing high. Vega, chief star of Lyra the Harp, is almost overhead. To its northeast lies Deneb in the thick of the Milky Way, a full magnitude fainter than Vega and the most prominent star of Cygnus the Swan.

Use binoculars to check out the area of sky around Deneb. If the night is dark and transparent enough, you should be able to pick out a large area of dim nebulosity 3° east of Deneb. This is NGC 7000, better known as the North America Nebula, so named for its distinctive shape.

The nebula spans almost three moon-widths, measures 45 light-years across and 1,600 light-years from Earth. It is very dim, almost lost in the sea of stars in this region of the sky, but patient observation will enable you to locate this feature, one of the most interesting features in the northern Milky Way. For more on the North America Nebula, look at the Observer's Challenge in last month's almanac.

Scan down the Milky Way to near the southern horizon where Scorpius the Scorpion lurks. Here you'll be treated to some of the richest star fields in the night sky. Antares, whose name is derived from an Arabic phrase meaning "Rival of Mars," is the 15th-brightest star in the sky at magnitude 0.9 and practically shines at the same brilliance as Mars, which now lies to the west.

Scorpius is one of the few constellations in our sky that actually looks like what it is supposed to represent — a scorpion. An arc of stars lying northwest of Antares denotes the claws of the scorpion, while its tail is represented by a graceful hook of stars to the south.

Scorpius has been identified with a scorpion for all of recorded history. In early times, the stars of Libra were also associated with the group. The names of its two brightest stars, Zubenelgenubi (Alpha [α] Librae) and Zubeneschamali (Beta [β] Librae), come from Arabic phrases meaning the southern claw and the northern claw. In Greek legend, the sting of the scorpion killed Orion, the famous hunter. The two constellations now lie in opposite regions of the sky.

Next to the scorpion's heart star Antares is one of the closest globular clusters to our solar system. Labeled M4 in Messier's list of nebulae and galaxies, it's also one of the easiest to locate.

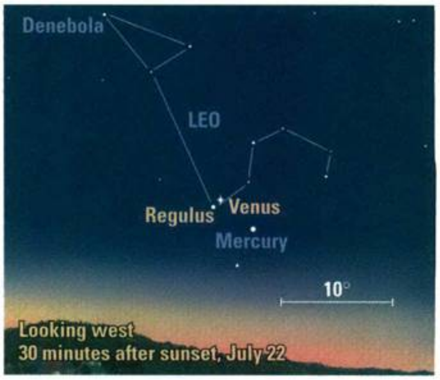
Center Antares in your telescope's field of view using a low power eyepiece. Now move 1.3° west; as you leave the ruddy glare of Antares leaves the field, M4 should come into view. Apply a higher power eyepiece to resolve some of the thousands of stars in this

July's Evening Planetary Groupings

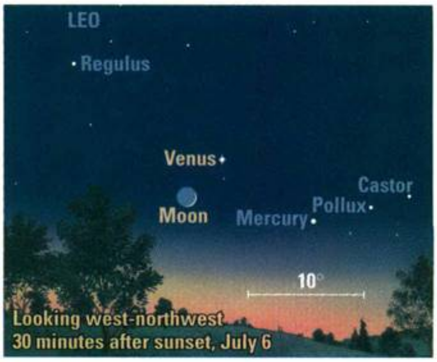
July is a perfect month for twilight walks and skywatching. Venus blazes low in the northwest after sunset, continuing to hold its own against the sun's glare the entire month. On the evening of July 6, a two-day-old crescent moon passes 5° south of the evening star, which shines all month at a brilliant magnitude of –3.9. The fattening lunar crescent then slips below Regulus on July 8, heading for a Mars approach on July 11 and a brush with Spica on July 12.

Conjunction activity continues after our moon leaves the evening sky. On July 22, Venus passes just over a degree north of magnitude-1.4 Regulus. Meanwhile, –0.1-magnitude Mercury climbs up toward a sinking Regulus to skim a mere half degree south of the star on July 26.

Bring along a pair of binoculars; these twilight conjunctions look best at low power in wide fields. You may want to try photographing these planetary gatherings against a terrestrial foreground, such as a tree or building.



Looking west
30 minutes after sunset, July 22



Looking west-northwest
30 minutes after sunset, July 6

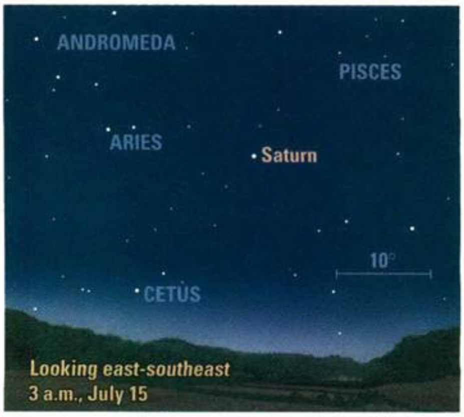
All illustrations by *Astronomy*: Elisabeth Rowan

Saturn's World of Detail

After last year's low bow, Saturn's rings are now shining in classic form. The system has opened up to 12°, almost half its maximum expanse. And with Saturn rising before midnight, backyard astronomers won't have to stay up all night to glean this planet's subtle, if not awe-inspiring, sights.

Keep a sharp eye out for white clouds that sometimes appear in regions south of the equator. These are zones of warm air belched up from deep within the planet. The white is ammonia ice crystallizing high in the frigid atmosphere. Another subtlety is Saturn's shadow on the rings. This effect will lend a magnificent three-dimensional look to Saturn's disk until we close in on the planet's October opposition. At that time, the sun will be at Earth's back, and the planet's shadow will fall straight back onto the rings, out of our sight.

One final ring feature of note is Cassini's division, which splits the rings into its two main parts. If you have a 6-inch or larger scope, look for the even thinner Encke gap, close to the outer edge of the rings. Summer's hazy evenings are often caused by large stable air masses that yield exceptionally steady views of the planets, so crank up the power. Slip into ranges between 250x and 400x — the scenery can be astounding.



Looking east-southeast
3 a.m., July 15

globular star cluster that shines across 6,900 light-years of galactic space.

Lying north of Scorpius is the sprawling constellation of Ophiuchus the Serpent-bearer, which covers a major part of the sky all the way up to Hercules overhead. North of magnitude-4.5 Psi (ψ) Scorpii lies a pair of 6th-magnitude stars, 16 and 18 Scorpii. **Pluto** currently lurks north of an imaginary line that joins these two stars, starting the month just over the border in Ophiuchus, but wrapping it up in Scorpius.

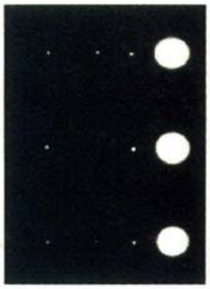
Begin your search for Pluto at local midnight, when the sky is at its blackest. As July opens, its faint magnitude-13.7 light glows within the same medium-power field of view as 18 Scorpii. You'll need at least an 8-inch scope and near perfect skies to glimpse the far-off planet.

To the east of Scorpius lies Sagittarius the Archer, home to the center of our Milky Way galaxy. Our galaxy's central bulge is betrayed by a widening of the Milky Way in this region of the sky. As you might expect when looking toward the crowded center of a galaxy, Sagittarius is chock-full of star clusters, globular clusters, and nebulae.

Most famous are the Lagoon and Trifid nebulae, M8 and M20 respectively, located within a few degrees of each other north of Gamma (γ) Sagittarii, the star that marks the spout of Sagittarius's teapot.

Any scope will show M8 as a cluster of stars bathed in a bright, elongated region of emission nebulosity. M20, on the other hand, is a combination of emission and reflection nebulae. The emission nebula in the

The Moons of Jupiter Unite

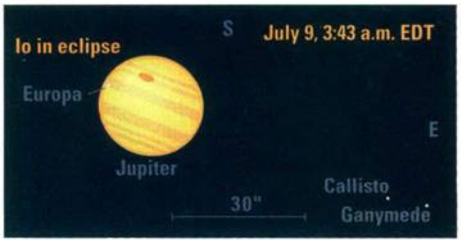

Davis Roles

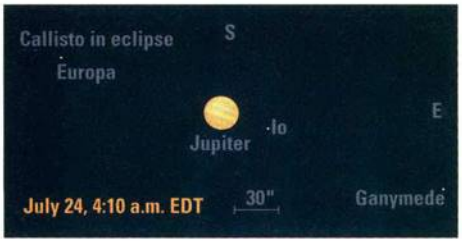
The summer of 1997 is an exciting time for Jupiter watchers. On top of the close-up views being radioed back from NASA's Galileo spacecraft, we see the planet's four big moons, the Galilean satellites, alternately eclipse and occult each other. Every six years the plane within which these satellites orbit tilts edge-on to an Earth-bound observer's line of sight. At this time, moons pass in front of each other (an occultation) or cast shadows upon one another to create eclipses.

Eclipses are very interesting to watch, even in a 60mm (2.4-inch) telescope. One moon slowly fades and then returns to full brightness as another moon's shadow plays across its face. Because the Galilean satellites are of similar brightness, it's easy to observe the light drop off and then recover. Occultations are also striking: That's when two fully lit disks gradually merge into a seemingly inseparable union, and then slowly draw apart over time.

Two notable mutual events favor North American observers this month. On the morning of July 9, Europa's shadow partially eclipses Io for just over two minutes, beginning at 3:41 a.m. EDT. Look for Io's light to dim 12 percent. A second shadow show for North America happens on July 24 between 4:04 a.m. and 4:16 a.m EDT. That's when Europa blocks just over 40 percent of the sunlight striking Callisto. Look for maximum eclipse around 4:10 a.m. EDT .

The current mutual event season runs through through next spring. For a complete listing of upcoming mutual events, consult an International Astronomical Union website on the Internet at http://www.bdl.fr/ phemu97_eng. html.

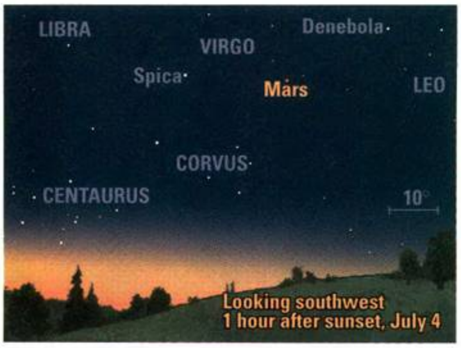




Find Pathfinder's Mars

July is when the surface of Mars gets its first robotic emissary from Earth in more than 20 years. If all goes well on July 4, headlines will announce that NASA's unmanned Mars Pathfinder has landed to begin a 30-day crawl across the martian surface. You can spot the planet Pathfinder will investigate about a third of the way up in the southwestern sky at dusk. Its magnitude-0.6 orange hue will contrast nicely with the icy blue of Spica, a little farther southeast. Use Spica as a reference point as Mars approaches and passes it in early August.

Unfortunately, the planet will appear disappointingly small during July through backyard telescopes, a mere 7" across. Pathfinder-smitten observers will be hard-pressed to discern any features at all, save for a small but very bright north polar ice cap.

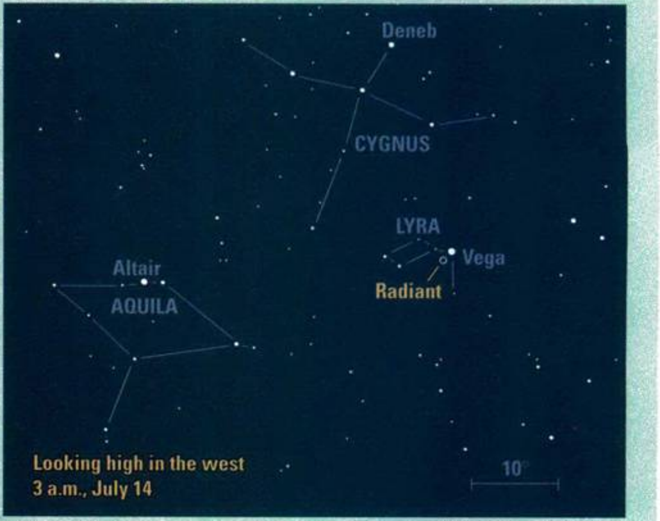


Looking southwest
1 hour after sunset, July 4

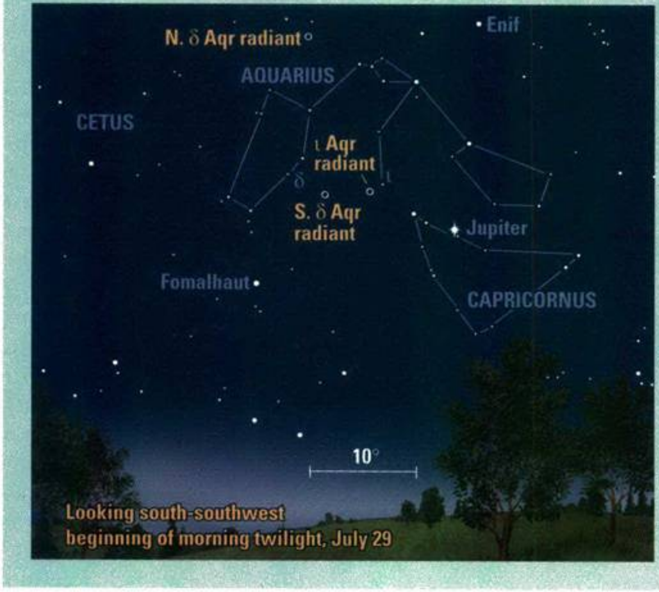
OBSERVER'S CHALLENGE: Summer's Forgotten Meteors

With its warm nights, splashy Milky Way, and famous August Perseids, it's little wonder that summer is also the season for meteor-lovers. But few backyard observers know there are at least five other active showers during July and August. Granted, these minor showers might pale in comparison to the bountiful Perseids, but together they account for about a quarter of all meteors seen on a late summer night.

The Southern Delta Aquarids are active between July 14 and August 18, and peak on July 29 to sport between 15 and 20 meteors an hour. Their sibling Northern Delta Aquarids sprinkle the sky from July 16 through September 16, with a maximum that coincides with the Perseids on August 13. On that date, expect to see up to 10 Northern Delta Aquarids an hour streak from the south-southeast. One final shower from the Waterbearer, the Southern Iota Aquarids, flashes July 1 through September 16 to peak at 8 meteors an hour on August 6.



Looking high in the west
3 a.m., July 14



Looking south-southwest
beginning of morning twilight, July 29

If you're looking for a real challenge, go for the Alpha Lyrids between July 9 and July 20. On peak night, July 14, you might glimpse an hourly rate of 1 or 2 meteors as bright as magnitude 4. Binocular observers have even seen up to 33 an hour coming from an area within 2° of the radiant near Vega.

In your hunt for the obscure meteors of summer, don't forget to start looking for the brighter Perseids beginning July 23. Light from a waning moon might pose problems for any meteor watching between July 20 and July 31. As with any meteor shower, the best time to look is in the hours approaching dawn. That's when the leading edge of Earth in its orbit around the sun plows directly into any meteoroids in our planet's path.

Trifid is crisscrossed by dark lanes of obscuring dust dividing it into three glowing masses, which give this object its name.

While you're scanning with binoculars, try spotting **Uranus** and **Neptune**. Both planets reach opposition this month near the Sagittarius/Capricornus border. Neptune reaches opposition on July 21, when it lies 29 astronomical units (AU) from Earth.

That distance is 29 times Earth's average 93,000,000-mile distance from the sun. Neptune's tiny 2"-diameter, magnitude-7.8 disk requires a good telescope to resolve its disk, confirming it as a planet. Look for Neptune south of a line that joins two 7th-magnitude stars that lie 3° southeast of the magnitude-6.0 star 57 Sagittarii.

Uranus is across the border in Capricornus, and is easier to see at magnitude 5.7. Opposition happens on July 29 and so, like Neptune, it is visible all night. It lies on the western side of the Seagoat, less that 1° south of magnitude-5.1 Upsilon (υ) Capricorni. Uranus's comparatively large 3.7" disk is an easier target than Neptune's. This tiny, greenish globe lies almost 19 AU from Earth in July.

Uranus gets its greenish cast from methane in its atmosphere. This gas readily scatters out the green component of sunlight. High-power and spacecraft photos of Neptune also show the same effect.

Standing in stark contrast to this elusive pair of giant planets is Jupiter, our solar system's largest planet, which appears nearby as a dazzlingly bright "star" on the eastern side of Capricornus. Its opposition comes early next month, but already the bright planet rises in the southeast soon after sundown. Jupiter's span of 48", more than ten times the apparent size of Uranus, makes remarkable features in its atmosphere a breeze to watch through a telescope.

This month Jupiter carves a retrograde, or westward, path as it swings between Gamma (γ) and Iota (ι) Capricorni. By July 21 its brightness peaks for the year, at magnitude –2.8, to outshine anything else in the night sky other than the moon and Venus. In tribute, our moon glides to within 4° of Jupiter that same day.

The final installment in our nine-planet tour, **Saturn**, rises due east shortly before midnight in Pisces. By July 31 it reaches magnitude 0.5 to the south of Zeta (ζ) Piscium. The rings are on fine display, a truly spectacular sight in any telescope. Keep an eye out for Titan, the largest moon of Saturn, in its two-week orbit around the ringed planet. It can even be spotted in binoculars if you look closely.

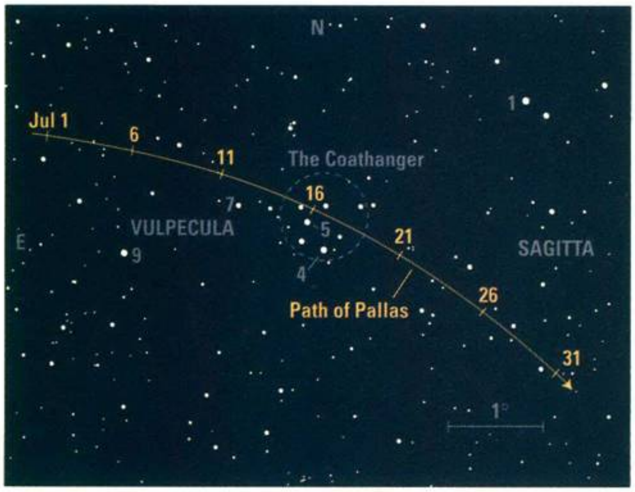
A waning gibbous moon passes close to Saturn on July 25, offering up an occultation for observers in Indonesia, northwestern Australia, and Hawaii. North American observers will get their turn at seeing a repeat of this event on September 18.

If you have pulled a marathon observing session and stayed up all night to see all nine planets, one more prize awaits you. On July 29 a slim crescent moon, replete with earthshine, creeps up and covers the star Aldebaran, the eye of Taurus the Bull.

This occultation will be a spectacular sight during the predawn darkness for observers in the western United States. Observers in the eastern half of the country will have the pleasure of seeing such a red star so close to a crescent moon. It will serve as a fitting end to a wonderful night. ■

Martin Ratcliffe directs the Henry Buhl, Jr. Planetarium in Pittsburgh, Pennsylvania. Alister Ling is a meteorologist for Environment Canada in Alberta.

Pallas Rides High



Asteroid 2 Pallas, the second asteroid discovered, serves up a rare treat this month when it passes right through the Coathanger cluster, a perfect binocular object just south of Cygnus's Northern Cross. Both cluster and asteroid lie in Vulpecula the Fox, a nondescript constellation sandwiched between Cygnus the Swan and Sagitta the Arrow, high in the summer Milky Way.

The Coathanger is a relatively recent addition to popular open star cluster lists. Instead of being faint, it is bright and sparse, so much so that 18th-century observers with their higher-powered telescopes simply scanned right through it without notice. Also known as Collinder 399, the cluster sports several naked-eye stars that, to the binocular observer, truly look like an upside down coathanger. Magnitude-9.6 Pallas will slide in front of this 5th-magnitude pattern between July 17 and July 20.

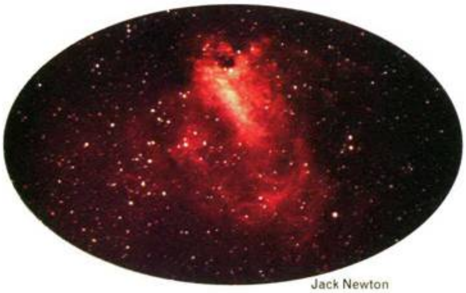
As if to celebrate the encounter, Pallas reaches opposition on the evening of July 19, when Earth lies directly between it and the sun. On that night the asteroid will shine at its brightest in about a year. But this year's apparition won't be one of Pallas's brighter oppositions. It happens when the asteroid is at its farthest point from the sun.

You might wonder why this faint asteroid is way up in Vulpecula when the majority of other solar system objects follow the ecliptic, which is down in Sagittarius and Scorpius this time of year. Pallas has an orbit that's inclined 35° to the plane of our solar system, the highest inclination of any known asteroid. Consequently, it can travel across a considerably wider part of the sky, far from where most other asteroids and planets are found.

Check In on a Stellar Nursery

Scan the summer Milky Way with any pair of binoculars and you'll see dozens of glowing gas clouds lighting up with the energy of newly-formed stars. One of them, M17 in Sagittarius, makes for a wonderful target through any-sized telescope under a dark sky.

M17 has a distinctive "numeral two" appearance when viewed at low power. This gives the deep-sky object other monikers like the Swan Nebula and Omega Nebula. Larger-aperture scopes, with 8-inch optics or larger, will start to show the Swan's mottled appearance as well as a whole network of fainter gas clouds that extend to the east. (The photo shows south at top, as the Swan appears through a telescope.)


Jack Newton

The young stars responsible for making M17 glow lie deep within the nebula, obscured by gas and dust. All told, there's enough material packed into an area 40 light-years wide to make 800 sun-type stars. In a few million years, M17 will become a glistening open cluster of stars.

LUMICON® ACCESSORIES MEADE® TELESCOPES

TOLL-FREE ORDER LINE 1-800-767-9576 EXPERT INFORMATION 1-510-447-9570 FAX 1-510-447-9589
LUMICON, 2111 Research Drive, Suites 4-5, Livermore, CA 94550 OPEN M-F 9-5, SAT 9-1 PST

LED FLASHLIGHT . $14.95

LUMICON LUMILITE™ Red LED Flashlight

This red LED flashlight preserves night vision. Uses 2 AA cells (incl.) which last 60-100 hours.

LUMILITE red LED flashlight **$14.95**

DRIVE CORRECTORS

LUMICON
UNITRAK

LUMICON UNITRAK DRIVE CORRECTOR

Operate your telescopes ***anywhere!*** Use the single-axis Unitrak with a 12V DC car battery. The dual-axis drives are for photography and use either 12V DC or 125V AC.

Unitrak™ single-axis corrector	**$99.95**
Unitrak with hand controller	**$139**
Convenient rechargeable Porta-Pac battery: 12V DC Porta-Pac (5AH) & recharger	**$89.50**

PENTAX 65° XL EYEPIECES

AMAZING performance! Full 20mm eye relief, adjustable helical eye guard, super multi-coating, 65° field.

Pentax 5.2mm, 20mm eye relief	**$279**
Pentax 7mm, 20mm eye relief	**$279**
Pentax 10.5mm, 20mm eye relief ...	**$269**
Pentax 14mm, 20mm eye relief	**$269**
Pentax 20mm, 1¼", 65° field	**$269**
Pentax 28mm, 1¼", 65° field	**$259**
Pentax 40mm, 2", 65° field	**$299**

RICH FIELD! 2° in 8'' SCT

NOW ONLY
$99.50

LUMICON Rich-Field Viewer on C-8 with LUMICON 2'' star diagonal and 2'' eyepiece.

The LUMICON Rich-Field Viewer fits **all** commercial Schmidt-Cassegrain telescopes. It has a high-performance coated achromatic focal reducing lens with 50mm or 80mm clear aperture for **totally unvignetted viewing** with 2" or 1¼" eyepieces. It is available in several combinations depending on the eyepiece and field-of-view you desire (see chart below).

LUMICON Rich-Field Viewer	**$99.50**
Giant Rich-Field Viewer (10-14") ..	**$250.00**

Optional Eyepiece	**TRUE FIELD**	**Price**
Meade 32mm Plossl	1.4°	**add $99**
Meade 32mm 2" Wide-Field†	1.9°	**add $459**
Meade 40mm 2" Wide-Field†	2.4°	**add $519**

†Includes 2" enhanced aluminum Star Diagonal (may not reach focus on some telescopes).

PROTECTIVE DUST COVERS

Protect your valuable telescope optics, eyepieces and accessories with these black vinyl covers. Add $1 shipping. Deduct 10%, 2 or more sets.

1¼" O.D. plug, seals focuser ...... **4/$2**

2" O.D. plug	**2/$2**	3½" O.D. plug	**$1.50**
1¼", 1⅜" ...	**3/$2**	7½"	**$10**
1½"	**2/$2**	9½", 10.4"*	**$15**
2"	**2/$2**	12½", 12⅞"* ...	**$20**
2⅛"	**2/$20**	15.0", 15.6", 16"*	**$28**
5½"	**$6**	19" (DS-16)	**$35**
*Fits Odyssey		21" (Odyssey-II)	**$35**

MEADE 7'' - 16'' LX200 *NEW! 7'' - 10'' LX50*

8'' LX50
$1395

16'' LX200 $14,950

Meade 8'' LX200 Telescopes

LX50 - includes dec. motor, hand controller.
LX200 - full computer control w/64K obj. mem.
Tripod: extra for LX50; included for LX200
NOTE: A wedge is **not** needed for visual observing with the LX200 Drive. Select f/10 or f/6.3 (no extra charge) for your LX200.

NEW! 3.5" f/14 ETX Maksutov ($20)	**$595**
Meade ETX, showroom price, no 6-10 mo. wait!	**$695**
8" LX10 w/wedge, hand controller ($65)	**$995**
Field Tripod for 8" LX10 ($20)..................	**$195**
8" LX50 w/wedge ($105 P&S).................	**$1395**
Adj. tripod for 8-10" SCT ($30 P&S).........	**$295**
8" LX200 w/computer ($105 P&S)..........	**$2795**
Wedge for photographing w/8" LX200	**$139**
7" LX50 f/15 Maksutov w/wedge ($125 P&S)	**$1795**
10" LX50 f/10 w/wedge, dec. motor, hand controller ($145 P&S)........................	**$1695**
10" LX200 w/computer ($145 P&S)........	**$3195**
12" LX200 (f/10 only) ($215 P&S)..........	**$4495**
Super Wedge for photogr. w/10", 12" LX200	**$395**
16" LX200 f/10 w/tripod ($385 P&S)	**$14,950**
Dew Shields: 8"..........$119; 10"..............	$129
12"........$189; 16"..............	$289

PHOTOGRAPHY ACCESSORIES

Cassegrain EASY-GUIDER 4", 8", f/6 or f/10	**$249**
Giant EASY-GUIDER for 10"/12" f/4-f/10 .	**$395**

MEADE STARFINDERS

8'' f/6
$749

New 8'' f/6 Meade Starfinder telescopes

See the Meade ad in this magazine for full descriptions. These are complete telescope systems with motor drive & finderscope (equat. only), mount, and 25mm (=48X) eyepiece. New DC motor runs on 4AA batteries.

6'' f/8 Dobsonian Starfinder ($46 P&S)	**$319**
6'' f/8 Equat. Starfinder 6(add $79 P&S) ...	**$649**
8'' f/6 Dobsonian Starfinder (add $59 P&S) .	**$419**
8'' f/6 Equat. Starfinder 8 (add $89 P&S) ...	**$749**
10'' f/4.5 Dobsonian Starfinder ($85 P&S) ..	**$599**
10'' f/4.5 Equat. Starfinder 10 (add $99 P&S)	**$879**
12.5'' f/4.8 Dobsonian Starfinder ($95 P&S)	**$895**
16'' f/4.5 Dobsonian Starfinder (freight COD)	**$1195**
16'' f/4.5 Starfinder 16 (ship. freight COD) .	**$2695**

*All Starfinder telescopes shipped directly from Meade to the purchaser. Please add the indicated packing & shipping charge to the price. Slightly lower P&S for payment by check. LUMICON showroom prices are $50-$100 higher.

ACCESSORIES

LUMICON carries all Meade accessories.

LUMICON Single axis drive corrector .	**$99**
Magellan computer; specify Dob. or Eq. ($15 ship)	**$295**
Meade 47M Dual-axis drive corrector with tangent arm & electric declination ..	**$475**

SKY VECTOR™ $299!!

Includes Computer, Encoders, Hardware

LOW PRICE—from $299

LUMICON SKY VECTOR FEATURES:

- "GUIDE" mode leads you to object
- Digital right ascension readout to 1 min.
- Digital decl. readout to 10 arc-min.
- 4000 pulse (0.09° accuracy) encoders
- Polar alignment ***not required!***
- Motor drive ***not required!***
- Just sight two stars to align!
- Works **equally well** for alt-azimuth telescopes like Coulter Odyssey and equatorial mounts like C-8, Meade 2080.
- **No need** to enter latitude, longitude, etc.

SKY VECTOR I™ $299

NEW! With over 220 object memory including the 110 Messier and 58 best NGC objects.

SKY VECTOR II™ $349

10,000 Objects! — Also includes Identify (Sky Tour) Function, planets and full visual descriptions.

NGC SKY VECTOR™ $439

12,000 Objects!— PC Serial Port

NGC-Sky Vector
OFF ON
DIM
MODE
ENTER
UP
DOWN
LUMICON

NGC SKY VECTOR with IDENTIFY (Sky Tour) mode, 12,000 object memory including the corrected RNGC catalogue, IC catalogue, P&K planetary catalogue, & much more!

Specify Telescope Type: Meade 2045, 2080, 2120, C-8, C-11, Odyssey 8, 10, 13, 17½, Alt-Azimuth, Meade 6-16'' Dobsonian.

Ultima 8, 9¼, 11 **add $25**, C-14 **add $75**

COMA CORRECTOR

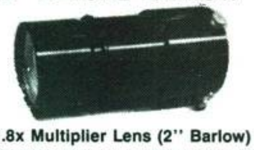
Coma 1 inch off-axis 17½'' f/4.5

Same field with LUMICON coma corrector; smaller, more numerous stars.

This computer-designed LUMICON 2'' lens reduces coma and flattens the field for both viewing and photography. **It threads into LUMICON 2'' EASY-GUIDERS for effortless installation.** This zero power lens does not change image scale nor shift focus, and all lens surfaces are multi-coated for highest efficiency. Clear aperture = 1.8".

LUMICON 48mm Coma Corrector/Field Flattener Lens	**$285.00**
LUMICON 2" EASY-GUIDER .	**$189.50**
2" EASY-GUIDER (Mamiya 645)	**$239.50**
2" Adapter for Pentax 6X7 ...	**$129.00**
2" Adapter for Hasselblad .	**$229.00**
2" Adapter for Bronica SQ-A	**$175.00**
2" Extension for viewing ...	**$26.00**

2'' DELUXE BARLOW



1.8x Multiplier Lens (2'' Barlow)

LUMICON 1.8x Multiplier Lens (2" Barlow) **$259.00**

LUMICON ACCESSORIES

LUMICON, Livermore, CA 94550 (510) 447-9570 FAX (510) 447-9589

LARGE UV/DUST SEAL

Protect the optics of your 8-14" Schmidt-Cassegrain with a UV/Dust Seal. Simply thread it onto the rear cell, then attach all normal accessories. The large size fits Meade 2120, Celestron-11 and -14 & has a high quality multi coated (removable) 72mm UV filter.

Deep-Sky Filter/Dust Seal for C-8, 2080 ...	**$119.50**
UV/Dust Deal for Celestron C-8 ...	**$39.00**
UV/Dust Seal for Meade 2080, 2045	**$39.00**
UV/Dust Seal (large) for Meade 2120	**$89.50**
UV/Dust Seal for Celestron-11, -14 .	**$89.50**

LOW PROFILE FOCUSERS New! Thread-on for Odyssey

FROM $69.50

LUMICON® LOW PROFILE FOCUSERS

LUMICON now offers 3 different low-profile helical focusers. They stand only 1¼-1½" above the telescope tube. Use the 1¼" or 2" versions for viewing. Use the 2" non-rotating focuser for convenient photography with the LUMICON 2" EASY-GUIDER™.

Select your desired base-plate shape! Coulter Odyssey (thread-on installation), Flat, 7" OD, 9½" OD, 12½" OD, 16" OD, 21" OD.

LUMICON 1¼'' Helical Focuser	**$69.50**
LUMICON 2'' Helical Focuser 1½" high	**$75.00**
LUMICON Non-rotating Helical Focuser	**$129.00**
2" Astro Systems focuser, only 2" high	**$139.00**
3 handles for non-rotating focuser	**$12.95**
2"/1¼" adapter w/48mm filter threads	**$20.00**
2'' LUMICON EASY-GUIDER	**$189.50**

LUMICON 50mm, 80mm SUPER-FINDER™

Visual Astronomers prefer the LUMICON 80mm SUPER-FINDER™, since hundreds of deep-sky objects, including most Messier objects, are visible directly. SUPER-FINDERS also make nice small portable telescopes. 80mm aperture, F=300mm coated achromat or 50mm, F=200mm coated achromat. Eyepieces and/or star diagonal are extra.

1¼" 50mm Finderscope **$69.50**, 45°version	**$69.50**
1¼" straight-thru 80mm SUPER-FINDER .	**$189.50**
1¼" right-angle 80mm SUPER-FINDER ..	**$199.50**
1¼" right-angle version, w/star diagonal ..	**$239.50**
25mm Cross-hair 1¼" eyepiece (12X)	**$59.00**
Large mounting rings for 80mm Finder	**$55.00**
1¼" Star Diagonal **$49**, Mounting Brackets,	**$39.50**
1¼" 45° diagonal for correct left-right views	**$59.50**

LOTS OF ADAPTERS

2" adapter for C-8, Meade 2080, etc. ..	**$29.50**
2" adapter for C-80, C-100 refractor ...	**$39.50**
2" adapter for C-70, C-80F, C-100F fluorite	**$39.50**
2" adapter for C-6, Comet Catcher, Meade 312	**$30.00**

EXTENSION TUBES

1" long 1¼" OD thread-in extension ...	**12.00**
2½" long extension (holds 1¼" filters) .	**19.50**
4½" long extension for 1¼" eyepieces	**$29.00**
3" long extension for 2" eyepieces* ..	**$29.00**
2" long extension for 2" eyepieces* ..	**$29.00**

VIEWING ADAPTERS

2"/1¼" reducing bushing,threaded 48mm*	**$25.00**
2"/T-thread adapter, threaded 48mm* ..	**$25.00**
T-thread/1¼" adapter	**$25.00**
F/10 2" or 1¼" eyepiece viewing adapter for Giant Easy-Guider	**$39.50**
Low profile star diagonal eyepiece holder	**$16.00**
Meade 2" Diagonal/Giant Easy-Guider	**$39.50**

**Threaded to hold 48mm filters.*

Meade & Celestron
LUMICON carries a full line of telescopes and accessories. Fast Delivery. Competitive Prices

LUMICON FOR HIGH PERFORMANCE

Visit our LUMICON web-site: http://www.rahul.net/Astro-Mall

NEW LUMICON MULTIPLE FILTER SELECTOR

ALWAYS GET THE BEST VIEW!

$99
(If ordered with filter or filter set)

The New LUMICON Multiple Filter Selector holds up to 5 1¼" LUMICON filters. The sliding bar has a click-stop at each filter position. Now you can instantly select the best filter for any deep-sky object. Cost is $129 or $185 with 1.5X relay lens (for Newtonians). **Save $30 if ordered with filter(s)!**

TELE VUE™

NEW! Bino Vue Binocular Viewer

Genesis-SDF 4" f/5.4 apochromat	$1950
Pronto 70mm f/6.4 apochromat w/2" diagonal	$939
Pronto 70mm f/6.4 w/45° erecting prism	$789
NEW! Bino Vue binocular viewer	$899
Gibraltar mount with ash wood tripod	$495
10.4, 26mm Plossl 50°	$79
8, 11, 15mm Plossl **$89**, 20, 25mm	$99
32mm Plossl, widest true field in 1¼"	$119
55mm 2" Plossl, widest possible field	$229
2.0x or 3.0x Tele Vue Barlow Lens	$115
2" Giant Barlow - 2x	$179
15mm Wide-Field, 1¼" eyepiece, 65°	$139
4.8mm Nagler, 82° field, 1¼" eyepiece	$169
7mm Nagler, 1¼" eyepiece, 82° field	$219
9mm Nagler, 82° field, 1¼" or 2"	$239
13mm Nagler, 82° field, 1¼" or 2"	$299
12mm Nagler, Type II, 82°, 1¼"/2"	$279
16mm Nagler, Type II, 82°, 1¼"/2"	$299
20mm Nagler, Type II, 82°, 2" only	$375
2" Paracorr Visual Coma Corrector	$249
15mm Panoptic 1¼", 68° field	$209
19mm Panoptic 1¼", 68° field	$245
22mm Panoptic 1¼"/2", 68°	$269
27mm Panoptic 2", 68° field	$319
35mm Panoptic 2", 68° field	$349

TeleVue Warranty may not be valid outside USA.

NEW! ENHANCED ALUMINUM DIAGONAL MIRRORS BOOST TELESCOPE PERFORMANCE

LUMICON 1.3" & 2.1" enhanced aluminum diagonal mirrors & 1¼" star diagonal.

The new LUMICON diagonal mirrors have a special enhanced aluminum coating with a protective overcoating for long life. Visible reflectivity is 94-96% compared to 86-89% for standard aluminum coated mirrors. The extra 5-10% transmission is like adding up to an inch of aperture! The substrate is fine annealed Pyrex flat to 1/8 wave.

1.32"	**$39.50**	1.52"	**$45.00**	1.83"	**$49.50**
2.14"	**$59.50**	2.60"	**$75.00**	3.10"	**$99.50**

ENHANCED ALUMINUM STAR DIAGONAL

90° star diagonals with 96% reflectivity enhanced aluminum mirrors in a CNC machined black anodized aluminum body. Performance far exceeds prism diagonals.

1¼" (1.32" mirror)	$99.50
2" (1.83" mirror)(see photo above)	$189.50

LUMICON FILTERS — BEST IN THE WORLD!

"The LUMICON O-III proved to be our favorite... It gave the greatest contrast gain." ***ASTRONOMY*, February 1991**

AMAZING O-III FILTER™

Helix Nebula, NGC 7293 in Aquarius. Bright and easy with Lumicon Oxygen-III Filter.

GREATLY ENHANCED DETAIL

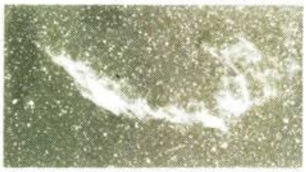
"Consistently performed well on all emission and planetary nebulae. Detail and structure were greatly enhanced in the more than two dozen objects I viewed." ***SKY & TELESCOPE*, July 1995**

BETTER THAN A DARK-SKY SITE!?

"From my light polluted backyard, the view ... was better with the O-III than with any other filter tested. The view was even better than without the filter from a dark-sky site." ***SKY & TELESCOPE*, July 1995**

SEE THE HORSEHEAD!

*"**LUMICON's H-Beta Filter** will show subtle features in emission nebulae that the others fail to reveal. It can't be beat for the elusive Horsehead and California nebulae. . ."* ***SKY & TELESCOPE*, July 1995**



"I CAN SEE THE VEIL NEBULA!"

Rich Zepernick saw the Veil Nebula for the very first time with a **LUMICON UHC Filter**. He stated, *"It was actually there! and not just around 52 Cygni, but the whole loop! Words cannot possibly express my feelings. I don't know how I managed without these filters."*
Rich Zepernick, Cresskill, NJ

DEEP-SKY FILTER™

BEST for Astrophotography!

"Stunning is all I can say," says noted astrophotographer Jack Newton. Great for BOTH color and black and white photography.

BEST WIDE-BAND FILTER!

*"Based on our tests we'd recommend a LUMICON Deep-Sky and Oxygen-III as complementary filters. The LUMICON Deep-Sky Filter clearly had the best contrast for **reflection** nebulae."* ***ASTRONOMY*, February 1991**

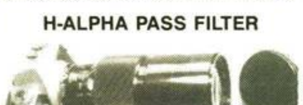
	Premium*
0.96" LUMICON DEEP-SKY Filter threads into most 0.96" eyepieces	$59.50
1¼" LUMICON DEEP-SKY Filter threads into most 1¼" eyepieces	$99.50
48mm LUMICON DEEP-SKY Filter (1.7" aperture), threads into most 2" eyepieces. Also fits LUMICON EASY-GUIDERS	$199.50
2" LUMICON DEEP-SKY Filter (1.5" aperture), threads into most 2" eyepieces. Also has male & female camera T-threads for prime focus photography	$199.50
72mm LUMICON Giant DEEP-SKY Filter (62, 67, 77mm adapter, $10, 82mm $16)	$399.50
2" Rear Cell Filter, fits SCT's Deep-Sky, **$199.50** UHC, O-III, H-Beta,	$199.50
1¼" LUMICON UHC Filter threads into most 1¼" eyepieces	$99.50
48mm LUMICON UHC Filter (1.75" aperture) fits most 2" eyepieces	$199.50
Choice of *any two* LUMICON filters (**Save 7%**) 1¼" **$185.00**; 48mm	$370.00
LUMICON H-BETA Line Filter (9mm bandpass at 486nm). For the California Nebula, Horsehead Nebula, and other extremely faint nebulae. **1¼" $99.50, 48mm**	$199.50
Oxygen-III Filter for very faint planetary and diffuse nebulae, 11nm bandpass at 496nm and 501nm O-III lines **1¼" $99.50; 48mm**	$199.50
LUMICON Comet (Swan band) Filter **1¼" $99.50; 48mm**	$199.50
Telephoto lens adapter for 2" or 48mm filter. Select 46, 49, 52, 55, 58mm	$7.95
Universal adapter for 1¼" filters. Adapts the 1¼" filters to any 1¼" eyepiece	$19.50
Universal adapter for 48mm or 2" filters. Allows use of any 1¼" eyepiece	$25.00

**Premium filters are currently the best in the world. All Lumicon filters include individually measured transmission data.*

ADJUSTABLE PIGGYBACK MOUNT

The LUMICON adjustable piggyback mount is ideal for telescopes of 6-16" aperture. It permits **both** vertical and sideways adjustment for optical alignment. Also ideal to mount LUMICON 80mm SUPER-FINDER™, large telephoto lenses and small telescopes up to about 5 lbs.
LUMICON Adjust. Piggyback Mount $59.50
Specify telescope size: 6", 8", 10", 11", 14", 16"

H-ALPHA PASS FILTER



Yields spectacular contrast gains in B&W photograph with telephoto lenses. Yields pinpoint star images. Superb with hypered 2415. For color, use the LUMICON Deep-Sky (DS) Filter.

Specify Lens Size	H-Alpha	(DS)
46, 48, 49mm	$59.00	$199.50
52, 55, 58, 62mm	$69.00	$199.50
67, 72, 77mm	$79.00	$399.50
82mm (77mm + adapter)	$89.00	$415.00

Hypered 2415 film, 36 exp . . **$11.95, $3/$32**

LUMICON®

2111 Research Dr. #5A, Livermore, CA 94550
For phone orders please call (510) 447-9570
FAX (6 PM-9 AM PST) (510) 447-9589
LUMICON Products catalogue FREE
All foreign orders add 8% ($10 minimum)
California residents add 8.25% tax.
Prices subject to change w/o notice.
Hrs: M-F 9 am - 5 pm, Sat. 9 am - 1 pm

DEEP-SKY ASTROPHOTOGRAPHY

SR-V 3200 NEW FILM

FILM HYPERSENSITIZATION KITS†

LUMICON HYPER-KITS™ yield 3-15x film speed gain in long exposures. They are safe & simple to use. Easy HYPER-KIT includes a chamber with all controls and fittings, thermometer, a refillable cylinder of non-flammable forming gas & hand-operated vacuum pump.

†U.S. Patent 4,473,636

MAKE YOUR OWN HYPERED FILM

MODEL 300 HYPER-KIT sensitizes any 35mm film in hours. Best for 2415. Achieves highest possible film speeds **$325**

MODEL 600 HYPER-KIT (See photo) Like the Model 300, but also sensitizes 120/220 larger format film and small glass plates **$395**

MODEL 1200 HYPER-KIT is for 4X5" plates and film up to 5X7". Has 2 gas cylinders and includes temperature controller . . . **$595**

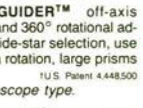
Temperature controller for any HYPER-KIT **$75**

Electric Vacuum Pump, Model R-10 **$325**

GUIDE OFF-AXIS FOR LOVELY ASTROPHOTOS

All **LUMICON EASY-GUIDER™** off-axis guiders† have both radial and 360° rotational adjustments for 5X easier guide-star selection, use 48mm filters, 360° camera rotation, large prisms for bright guide-stars. †U.S. Patent 4,448,500
Specify Camera and Telescope type.

NEWTONIAN EASY-GUIDER™



Full aperture. Installs in seconds. Specify 2" or 1¼".

NEWTONIAN EASY-GUIDER	**$189.50**
48mm Coma corrector/field flattener	**$285**
3X Relay Diagonal (see photo)	**$99.50**
Illuminated reticle eyepiece, pulsed	**$109.50**

Guider for Hasselblad **$409,** Mamiya 645 **$199**
Pentax 6X7 **add $119;** Pentax 645 **add $139**

CASSEGRAIN EASY-GUIDER™

For C-8, Meade 2080, Cynamax-8. Includes 50mm achromatic lens for f/5.8 operation—3X shorter exposures! **Superb rich field viewing, too!**

CASSEGRAIN EASY-GUIDER **$249.00**
Adapter for Hasselblad **$225,** Mamiya 645 **$98**
Pentax 6X7 **add $119;** Pentax 645 **add $139**

GIANT EASY-GUIDER™

For Celestron-11, C-14, and the 10-12" Meade. Includes 80mm clear aperture achromatic lens for edge-to-edge illumination & pin-point star images. F-ratio adjustable f/4-f/11. **Also yields unmatched Rich-Field viewing.**

GIANT EASY-GUIDER **$395.00**
48mm DEEP-SKY Filter ordered with any EASY-GUIDER (SAVE $20) . . . . . **add $99.95**
Adapter for Hasselblad **$295,** Mamiya 645**$149**
Pentax 6X7 **add $129;** Pentax 645 **add $149**

WHAT DO YOU NEED?

1. **Illuminated reticle eyepiece** . . . **$109.50**
Lumicon 12mm eyepiece system has adjustable LED illumination, dual crosslines, pulsed.

2. **Cable release** for long exposures **$9.95**

3. **Declination motor** (state telescope type) **$109**

4. **Dual-axis drive corrector** for telescope. This should be part of the telescope when purchased. Call LUMICON for details.

5. **LUMICON EASY-GUIDER** (selection to left)

6. **LUMICON 48mm DEEP-SKY FILTER $199.50**
This is essential for highest possible contrast. Contrast is boosted up to 3X for ***both*** color or black & white photos. The 3 photos in this ad showing the Helix Nebula, Horsehead Nebula and Veil Nebula were all made using a LUMICON 48mm DEEP-SKY FILTER.

7. **Hypersensitized film.** Purchase from LUMICON or make your own with a LUMICON HYPER-KIT.

TRY PPF! HYPERSENSITIZED FILM

SR1600
Scotch
1000
TP 135-36

HYPERED FILM IS 2-10X FASTER!

LUMICON Hypersensitized film is essential for good deep-sky astrophotography. Deduct 10% for 3 or more rolls (mixed o.k.). ***No C.O.D.s.***

Film Type, 35mm	Exposures	Price
Kodak PPF-400, THE BEST!	36	$14.95
2415, Ultra-fine B&W, red sens.	36	$11.95
SR-G3200, fastest of all, color neg	24	$13.95
Kodak Gold 1000 fast, fine grain	12	$13.95
Fuji G800 fine grain color neg.	**24**	$13.95
Ektachrome 1600, fast slide film	24	$14.95
Fujichrome RD100, fine grain slide	24	$12.95
D-19 B&W Developer	1 gal.	$6.95

Jason Ware

DUSTY INFANT STARS:

A Fine Sight

Meet the nearest star clusters.
They're in your neighborhood.

by Edmund A. Fortier

Open clusters of stars are among the most beautiful of all deep-sky objects. These loose collections of young suns, some still shrouded in the dust and gas of their birth, contain anywhere from several hundred to several thousand members. Typically compressed, wreathed in bright and dark nebulosity, and fired by the light of hot infant stars, they are dazzling sights, even in a small telescope.

Yet on a galactic time-scale, their splendor is ephemeral. As a cluster ages, residual dust and gas get swept away and the brightest, most massive stars evolve into red giant stars. At the same time, our galaxy's rotation causes a closely-packed cluster to slowly move apart. Eventually stars become so widely dispersed that the cluster ceases to exist. This gradual scattering of star clusters is a fundamental process at work in our galaxy.

As it happens, five open clusters lie within 500 light-years of the sun. They range from relative youth to staid middle age and, when viewed in that order, represent almost 600 million years of star cluster evolution. Keep in mind, though, that their apparent diameters are much too large for high-powered telescopes; to see these objects at their best you'll need either binoculars or a rich-field telescope.

One favorite binocular target, the **Pleiades** (M45) in Taurus, is the youngest and most beautiful of the nearby groups. Only about 78 million years old, this cluster still retains much of its youthful brilliance. Though it lies more than 400 light-years away, it spans almost 2° of sky and shines with the combined light of a 1.2-magnitude star. Most naked-eye observers can spot five or six Pleiades, and under ideal conditions it's possible to count a dozen or more. A telescope reveals scores of additional stars, but the Pleiades is actually much richer than it appears in small backyard scopes. So far astronomers have identified nearly 300 cluster members, and they think there may be as many as 500 in all.

In binoculars the Pleiades is a stunning sight. The five brightest stars comprise the cluster's core, a dipper-shaped asterism about 1° across. These stars, all blue-white giants, are dazzling reminders that this cluster, though still quite young, is well out of its infancy.

If you observe the Pleiades on an exceptionally dark and transparent night, be sure to look for an elusive clue to its youth. Just south of Merope, the Pleiad at the southeastern corner of the dipper's bowl, lies a faint nebulosity designated NGC 1435. Also known as Tempel's Nebula, this delicate wisp is the most visible portion of a vast cloud of dust that still surrounds this cluster, the last remnants of a dusty birth.

Now imagine an open cluster twice as old as the Pleiades and more than five times closer to us in space. How might such a group appear? Probably all traces of the dense dust cloud that once surrounded it would be gone. Gone too would be its brilliant but short-lived, large, hot stars, the very ones that make the Pleiades so spectacular. Moreover, because of its proximity, this cluster would loom exceedingly large in the sky, much too large even for binoculars.

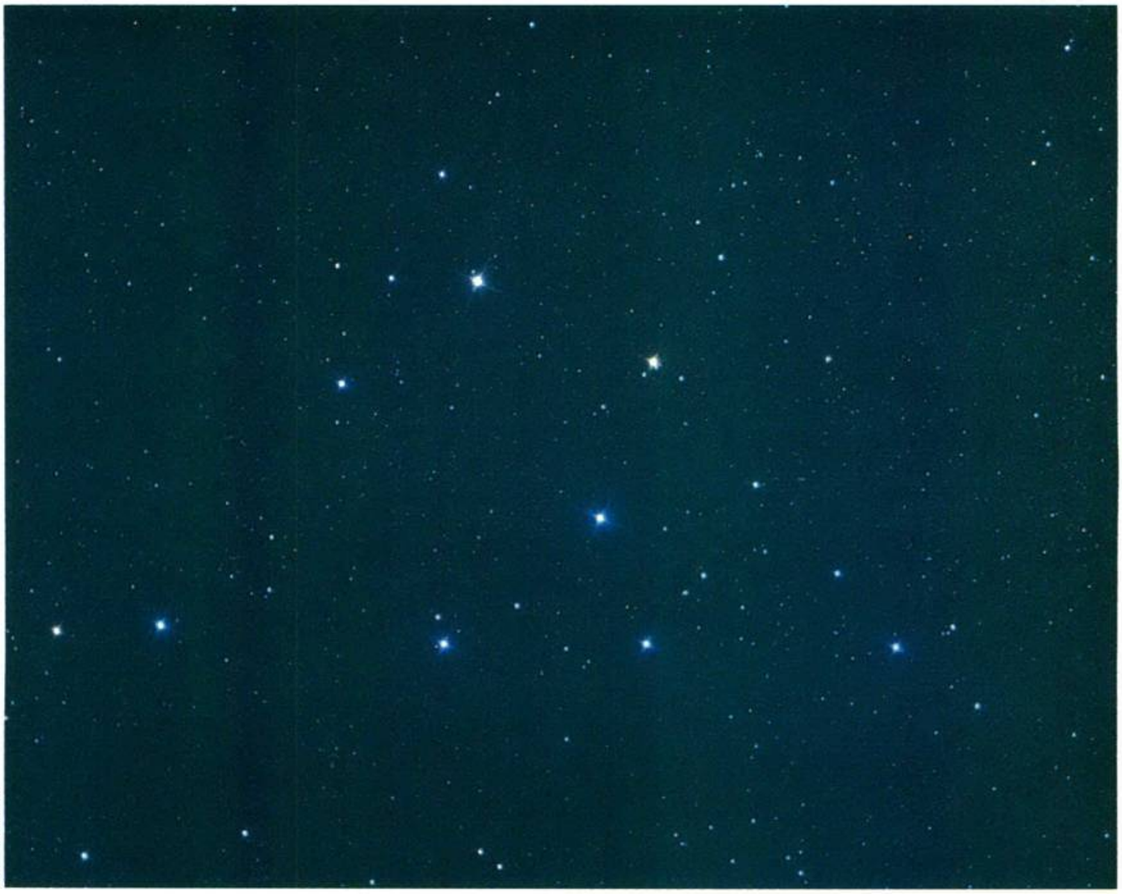
Such a cluster does exist, though many stargazers seem unaware of it. Its designation is **Collinder 285**, and it comprises much of the constellation Ursa Major. In fact, all but two stars that make up the best-known part of Ursa Major, the Big Dipper, belong to this group. The two impostors are Alkaid (Eta [η] Ursae Majoris), located at the tip of the Dipper's handle, and Dubhe (Alpha [α] Ursae Majoris), the northernmost of two "pointer" stars that flag Polaris.

Unlike the Pleiades, this is an extremely sparse cluster. It contains some 16 members scattered across a full 23° of sky. About a dozen of these stars can be seen with the unaided eye. A few can be found in nearby constellations, chief among

Dipper-shaped M45, the Pleiades (opposite page), still lies cloaked in the dust of its genesis.

Dewey Vanderhoff

Ursa Major's Big Dipper, seen over Yellowstone's Old Faithful geyser, is perhaps the biggest open cluster in the sky.



The Coathanger lies nestled in Vulpecula just under the Northern Cross of Cygnus.

Michael Stecker

them 2nd-magnitude Alphecca (Alpha [α] Coronae Borealis), the brightest jewel in the Northern Crown. Collinder 285's most famous member is Zeta (ζ) Ursae Majoris, better known to most backyard astronomers as Mizar.

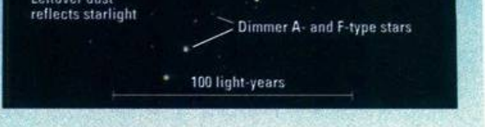
Marking the bend of the Big Dipper's handle, Mizar and Alcor form an optical double that's easily resolved with the naked eye. The pair don't necessarily orbit each other, but lie along our line of sight. Mizar is a true double: Use a small telescope to look for a 4th-magnitude companion 14" south-southeast of magnitude-2.4 Mizar A.

Inside an Open Star Cluster

Open star clusters scatter themselves throughout our Milky Way, constantly replenishing our galaxy's population of stars. Astronomers have cataloged about 1,000 of them that range in age from 1 million to 4 billion years old. Each formed from its own gas and dust cloud; today's emission nebulae, like the Lagoon Nebula (M8) and the Omega Nebula (M17) in Sagittarius, will transform into star clusters over the next few million years.

First to emerge from the glowing gas caldron are massive blue and white O- and B-type stars, with lifetimes of a few tens of millions of years. Their winds blow away any remaining dusty chrysalis to reveal longer-lasting yellowish-white and white type-A and -F stars.

Over the course of several hundred million years, most open clusters get ripped apart by tidal forces rippling from the galaxy's center and the shearing tugs of nearby spiral arms. Eventually, component stars drift away to join the countless single, double, and multiple stars spread throughout our galaxy's disk.



An Open Star Cluster at 40 Million Years

Brilliant O- and B-type stars
Leftover dust reflects starlight
Dimmer A- and F-type stars
100 light-years

Moving to the east across a quarter of the sky, we come to the constellation Vulpecula and our next object, **Brocchi's Cluster** (Collinder 399). At a distance of about 425 light-years, this 200-million-year-old cluster is a little farther away than the Pleiades and slightly older than the Ursa Major group. Shining at magnitude 3.6, its several dozen members look to the unaided eye like a smudge against the Milky Way. Through a telescope, the cluster's well-separated stars fill a 1° field of view.

The most intriguing feature of Brocchi's Cluster is its shape. A row of six 5th- and 6th-magnitude stars form an east-west line while, at the mid-point, four others curve to the south. In a wide-field eyepiece it looks just like an upside down coathanger. The bright star to the south, 4 Vulpeculae, is an orange giant, the first we have seen so far. To the east lies 7 Vulpeculae, a background star appearing here only by chance.

About halfway between Canes Venatici and 2nd-magnitude Denebola in Leo lies another familiar object, the **Coma Berenices Star Cluster** (Melotte 111). With an age of 400 million years, this misty cloud of light is twice as old as Brocchi's Cluster. But because it lies so much closer to us — only 260 light-years away — Melotte 111 is much more conspicuous to the naked eye. The cluster's 80 or so members measure nearly 5° across and glow with an integrated magnitude of 1.8.

Although Melotte 111's true size is similar to that of the Pleiades, M45 contains about four times as many stars. Still, the Coma Berenices cluster is a fine sight in any instrument with a field of view large enough to accommodate it. One of its brightest members is 17 Comae Berenices. This wide pair of 5.3- and 6.6-magnitude suns, just east of the cluster's center, is easily resolved in binoculars or a finder scope.

The oldest of any nearby cluster is the **Hyades**. Located just 12° southeast of the Pleiades, this V-shaped array of stars outlines the muzzle of Taurus the Bull. Astronomers believe the Hyades was formed 660 million years ago, more than half a billion years before neighboring M45. At a distance of 150 light-years, it is the nearest cluster to us after the Ursa Major group. If the 5.5° span of the "V" seems small for a cluster this close, keep in mind that this represents only its core. The Hyades actually contains more than 20 stars brighter than 6th-magnitude strewn across an area of sky 24° in diameter.

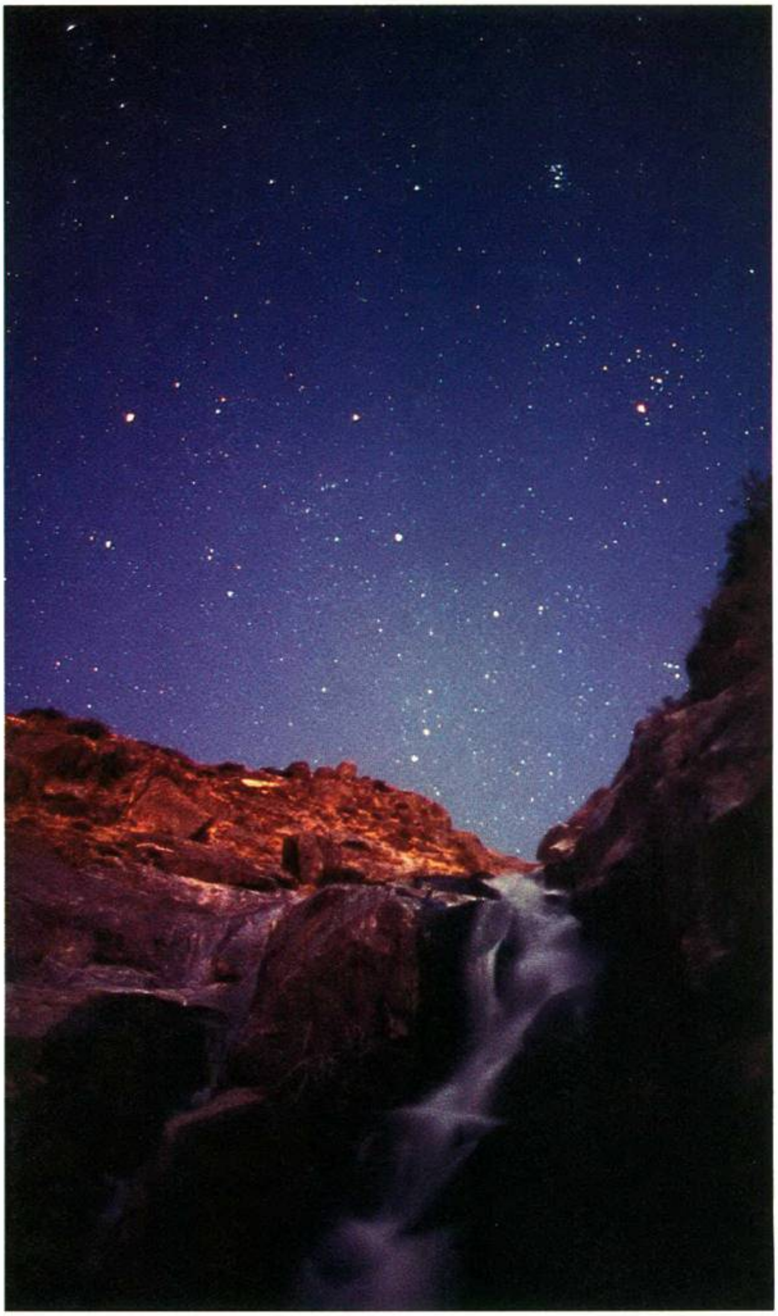
A binocular view of the Hyades reveals a typical middle-aged cluster. Unlike the previous objects, this group boasts a number of red giants among its brightest stars, like magnitude-3.6 Gamma (γ) Tauri, which marks the apex of the "V." Also included are 4th-magnitude Delta^1 (δ^1) and Epsilon (ε) Tauri, both of which lie in the Hyades's northern "branch." If you can't detect an orange hue to these giants, try comparing them to Delta^3 (δ^3), a 4th-magnitude A2 sun southwest of Epsilon.

Several more stars worth viewing linger in and around the Hyades's southern branch. Magnitude-3.4 Theta^2 (θ^2) Tauri, located midway along the arm, is the cluster's brightest member. Together with Theta^1 (θ^1) Tauri, a 3.8-magnitude K0-type giant, it forms a close naked-eye double. The tip of the branch is marked by the brilliant foreground star, Aldebaran. About a degree to its southeast lie the twin suns Sigma^1 (σ^1) and Sigma^2 (σ^2) Tauri. However, unlike the two Thetas, this wide pair is an optical double lined up along our line of sight. Only the northern star, Sigma^2, is a true cluster member.

With the Hyades, you've just explored five of the closest and most unique star clusters. Now grab a star atlas to find dozens more that lurk farther away in areas adjacent to our sun's neighborhood. Small telescopes will reveal many as nothing more than smudges of light. Bigger instruments, with optics larger than 6 inches, will show individual stars.

Don't be afraid to up the power; clusters were made for it. Each grouping takes on a character of its own when observed under a variety of magnifications. Soon you will develop a list of your own favorite objects. At the same time, you will grow to appreciate how our galaxy renews itself with fresh stars over hundreds of millions of years.

Edmund Fortier furthers his exploration of star clusters from North Scituate, Massachusetts.



Jerry Schad

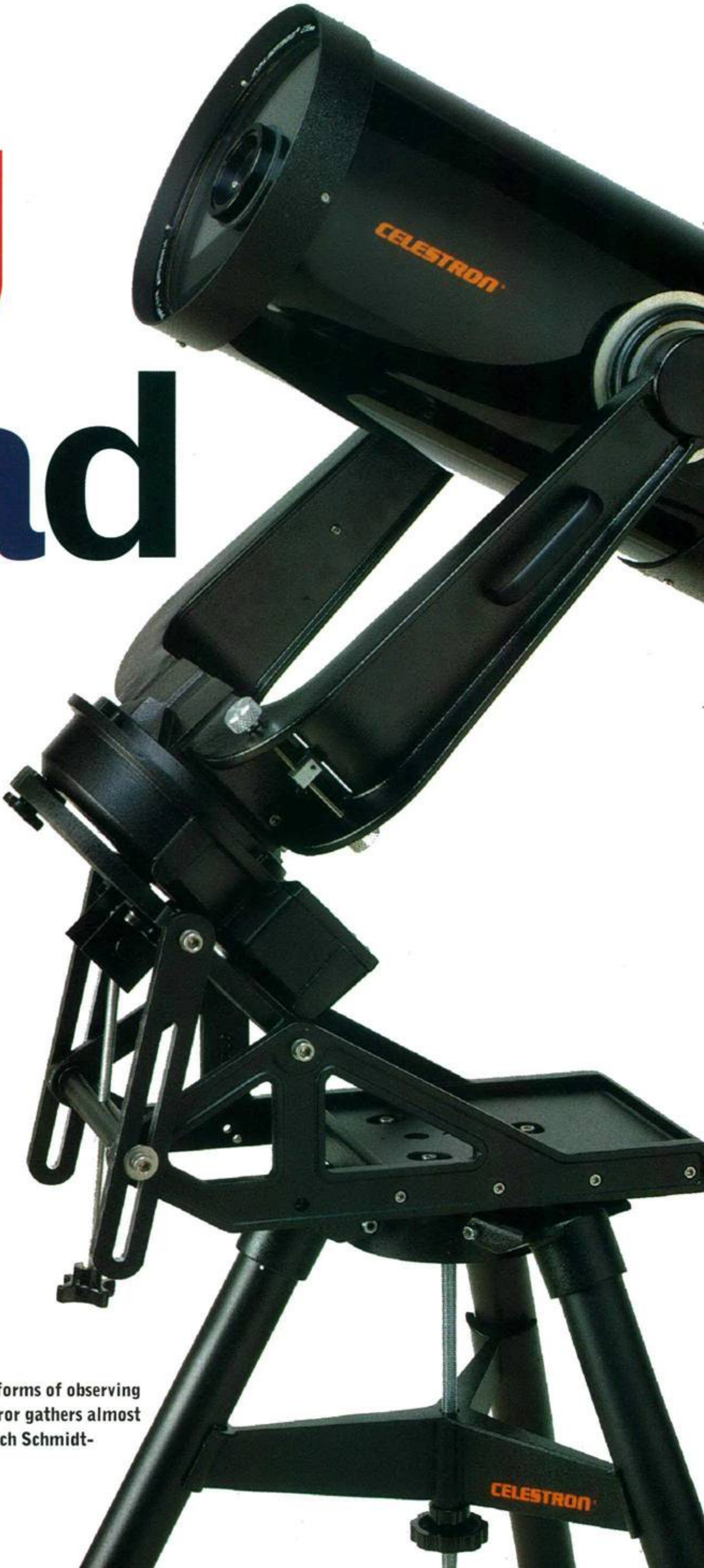
Look above and to the right of the waterfall in this time-exposure for the V-shaped Hyades, the head of Taurus the Bull. The Dipper-like Pleiades is the grouping of stars above the Hyades.

CELESTRON'S

Big Bad Cat

An upsized Schmidt-Cassegrain Scope Fits in a Compact Tube

by John Shibley



The Ultima 9¼ is ready to take on all forms of observing and astrophotography. Its primary mirror gathers almost a third more light than the typical 8-inch Schmidt-Cassegrain telescope.

Does the world really need a 9¼-inch SCT in this age of the 8-inch folded scope? Anyone who's ever handled an 8-inch SCT knows that, for its size, it's remarkably compact and easy to set up. But like any other scope, an SCT becomes more of a handful the bigger it gets. While a 32-pound, 8-inch SCT might be a breeze for one person to handle, the bulk and 60-pound weight of a 10-inch SCT present a hauling job meant for two.

In the face of this reality, Celestron's 9¼-inch SCT is optimized to yield maximum aperture into a package designed for one-person portability. The main mirror captures 34% more light than a traditional 8-inch Schmidt-Cassegrain telescope, all in a tube assembly that weighs only 48 pounds. The bottom line is you get more light-gathering power for the muscle strain.

Celestron's 9¼-inch SCTs come in two tripod-mounted versions. The Ultima 9¼ has a popular fork design ideal for general-purpose observing and astrophotography. The CG-9¼, on the other hand, comes with a German equatorial mount. Most preferred by astrophotographers, this type of mount makes its easier to balance the telescope tube for better tracking and also provides greater flexibility in piggybacking a variety of astrophoto accessories.

Because of the broader appeal of its design, we've decided to review the Ultima 9¼ first; look for a thorough assessment of the CG-9¼ in an upcoming issue of *Astronomy*.

Have Fork, Will Travel

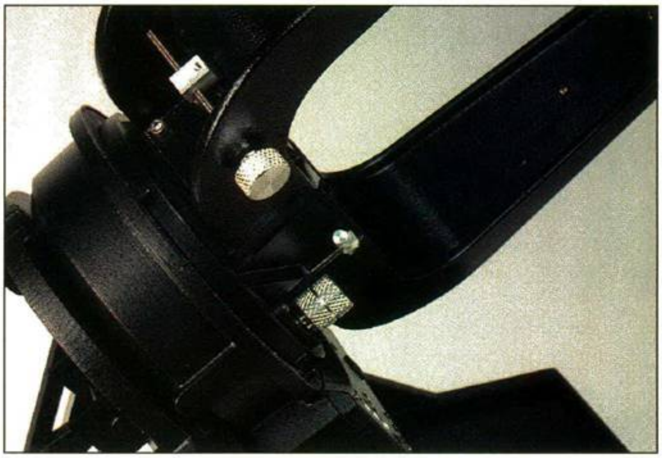
The venerable fork-equatorial mount has been around in a commercial form for at least three decades. The optical tube assembly, the heart of the Ultima 9¼, attaches to the fork through bearings that let the scope nod up and down in declination. When you're not observing, the tube conveniently swings and locks between the fork for easy transport and storage.

The right ascension, or polar, axis bearing is built into the fork's base. It incorporates a motor which drives the axis so the scope can track with the sky. In order to do this properly, the axis must point close to the celestial pole, around which the entire sky appears to rotate over the course of an evening.

You polar-adjust the Ultima 9¼ using a wedge which sits between the telescope's fork base and its tripod. Three hand knobs, which thread into the telescope's fork base, secure the fork assembly to the wedge. One knob slides into a slot in the wedge which serves to guide the scope base into a position that accepts the other two knobs.

In a test of manual dexterity, I had to back the first knob up its slot about half an inch before holes for the other two knobs lined up, all while holding the scope steady with one arm. Set-up would be much easier if Celestron machined this front slot so the knob seats securely when the other two holes line up.

The process of polar alignment has always been easy with a fork equatorial mount. Unlock the declination axis and swing the telescope tube out so it's parallel to the fork. Adjust the fork's angle through the equatorial wedge and nudge the tripod head left and right until Polaris comes into view. That's all that's required for general viewing; long-exposure astrophotography might require you to precisely locate the pole, some 1° from Polaris.



All photos by *Astronomy*: Jim Forbes

Aluminum knobs let you manually adjust Ultima's right ascension and declination axes.

Rate du Jour

Once the Ultima is set up and polar aligned, you can select from a variety of tracking speeds and features built into its drive electronics. A console built into the fork's base affords four different drive settings: solar, lunar, sidereal, king. You choose which drive rate to use by pushing a button on the console's display.

The sidereal setting tracks at just the right rate to follow the stars. A solar rate shadows the sun's apparent motion through the sky, which is slightly slower than the sidereal rate. The lunar rate takes into account the effects of our moon's independent motion around the Earth. King is usually used for observing things less than 15° above your horizon. It accounts for the optical effects of Earth's atmosphere on an object's apparent position.

The Ultima's hand controller, which plugs into the console, lets you adjust the scope's ability to slew. Two buttons speed up or slow down the scope in right ascension. Pressing and holding the buttons will slew the scope at up to 400% its normal drive rate. Two more directional buttons control an optional declination drive motor. Without it, you must adjust declination by hand using a knob built into the right fork. Another pair of buttons operates a focuser motor that's also available separately. Finally, the controller features a built-in LED map light you activate with a push-button switch.

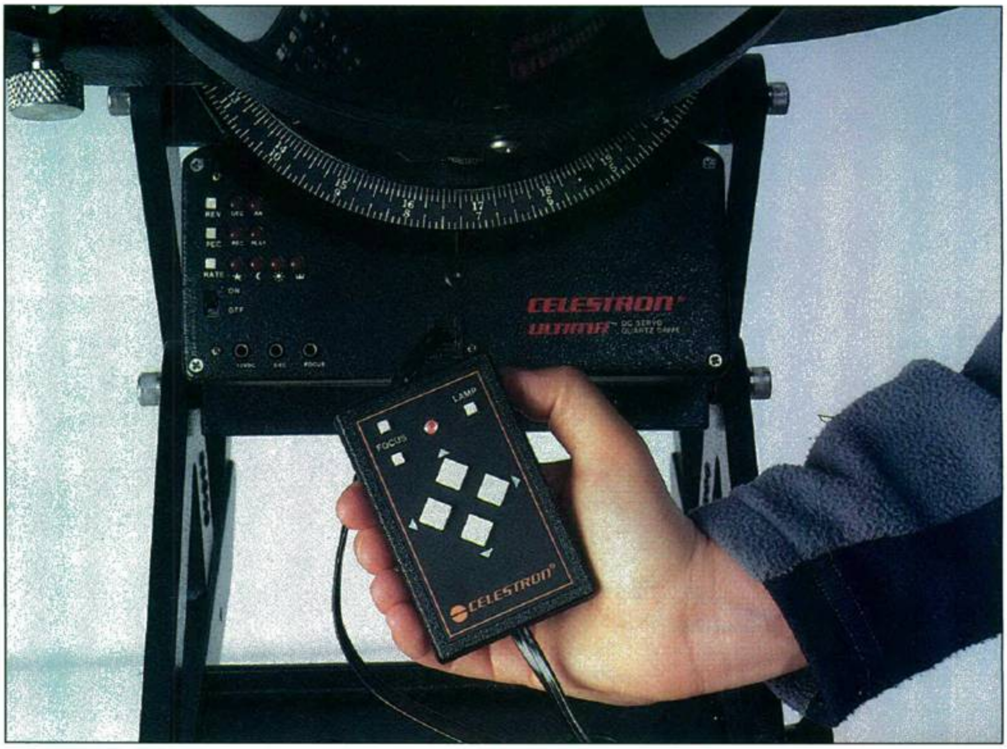
Ultima's drive electronics also incorporate something that dramatically reduces the number of times you'll have to make tracking adjustments with the hand controller during long-exposure photographs. Called Periodic Error Correction, or PEC, the feature works around a subtle but detectable "slop" found in the drive's main gear.

First off, it's important to know that all drive mechanisms have some form of repeating tracking error as their main gears turn. Eliminating this type of error through more elaborate machining would drive up a scope's cost considerably. So scope engineers work around gear discrepancies by relying on a computer chip that can automatically speed up or slow down the drive motor as it encounters drift errors. You "train" the chip before a night's astrophoto session.

How?

After polar aligning and turning on the scope's clock drive, activate the PEC feature and then track a star through the scope with a high-power eyepiece, keeping it centered by using control buttons on the hand paddle. The PEC memorizes what corrections you make during the four to six minutes it takes the drive's main gear to complete one turn. During subsequent tracking sessions, the chip will then play back those corrections to reduce the number of corrections you'll have to make.

Ultima's focuser features a built-in digital display to calibrate the focus for a variety of visual and photographic accessories.



A plug-in hand controller slews the scope at different rates. It also runs optional declination and focuser motors. A built-in red LED amply illuminates maps, books, or accessories.

The drive that came with the Ultima 9¼ I tested drifted across a span of 15", slightly wider than Mars's maximum apparent diameter this past spring. After activating and calibrating the PEC, this drift dropped to around 3", a little less than Uranus's apparent diameter through a telescope. Tiny indeed!

Power for all these options comes from a 9-volt battery inside the fork base. Changing the battery could be somewhat of an inconvenience. To get to it, you must loosen four screws that secure a control panel coverplate. The need to keep track of loose screws and repack some wiring makes a battery change-out something you should do indoors with adequate lighting.

Celestron cites a 35-hour battery life in the Ultima's owners' manual. My tests in temperatures that often dipped below 0° F made for a battery life closer to 24 hours. Its lifespan could shorten considerably if you slew with an optional declination motor as well. If you plan to pan across the sky often with Ultima's drive motors, I'd recommend purchasing a power cord that plugs into a car's cigarette lighter. Having to change a 9-volt battery once a month might get tedious, even though the whole process takes less than five minutes once you master it.

Down to Brass Tacks

Riding on top of the electronic choices is arguably the most important part of an Ultima 9¼ — its optical tube assembly.

The tube assembly features all-metal fittings. Its wall is made of rolled aluminum and finished in a glossy, black paint. Front and rear cells are made of cast aluminum with a black, textured finish. Theoretically, this all-black approach should yield cooldown dividends. Just as black is efficient at absorbing energy, it's also willing to radiate it away. Aluminum also conducts temperature differences very readily as well. The Ultima 9¼ tube assembly I evaluated cooled from room temperature to around freezing in about 45 minutes. In the meantime, undulating cells of still-cooling air trapped within the closed tubes degraded views through the eyepiece.

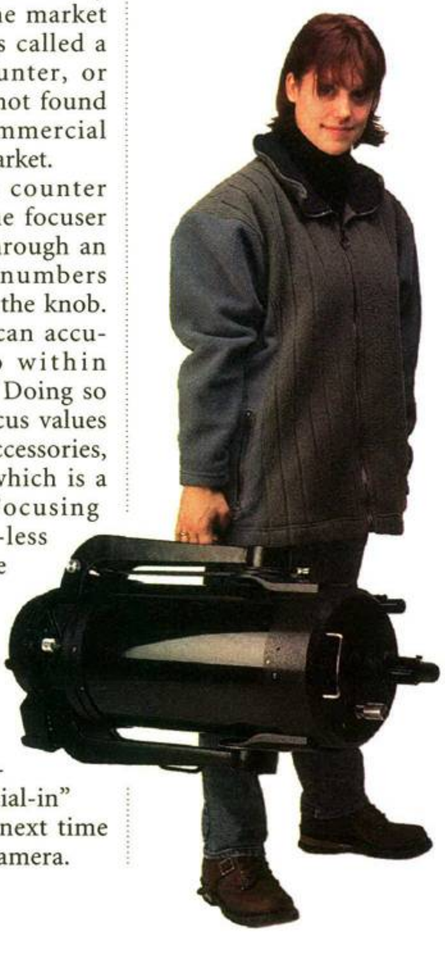
Built-in ventilation fans would really tip the scales in favor of rapid cool-down times. Perhaps out of necessity due to all its glass, the Meade 7-inch Maksutov-Cassegrain tube assembly includes such a fan (see "Big Mak Attack," in last month's issue of *Astronomy*). Bigger SCTs, in the 9¼ to 14-inch range, with similar levels of thermal inertia would undoubtedly cool faster if customers were willing to shoulder the incremental expense of including such a useful feature. Think about it . . .

There's one feature on the Ultima 9¼'s tube assembly Celestron feels the market will embrace. It's called a digital focus counter, or DFC, something not found on any other commercial telescope on the market.

A three-digit counter integrated into the focuser clicks a display through an astounding 100 numbers with each turn of the knob. This means you can accurately focus to within 1/1000 of a turn. Doing so lets you preset focus values for a variety of accessories, not the least of which is a CCD camera. Focusing these viewfinder-less cameras can be time consuming. But with a DFC, after you've gone through an initial focusing session, just note the focuser's readout so you can "dial-in" proper focus the next time you hook up the camera.

However, the counter system does have one potential shortfall. Its three-digit display recycles four times from 000 to 999 during the 32 turns of the focus knob needed to run through the scope's full range of focus. This means an identical digital reading could appear four times. You might dial in an accessory's precalibrated focus number several times over the scope's full range of focus. While a fourth numerical readout digit would eliminate this possibility, I found most focus applications fell within nine turns of a focus knob.

Ultima's 9¼-inch mirror sits at the heart of the tube assembly. I performed standard tests on the optic by examining a pattern created by a 133-line Ronchi grating at focus. The pattern's smooth, evenly-placed parallel lines revealed a mirror that provided top performance. The Ultima's exceptional optics let me enjoy crisp, clear views of Mars during the days it approached opposition.



While up one morning to see Comet Hale-Bopp in the pre-dawn sky, I panned over to Epsilon (ε) Lyrae, the famous "double-double." The Ultima 9¼'s optics not only split ε^1 Lyrae (2.8") and ε^2 Lyrae (2.2") into clean disks, as I expected it would, but did so rather handily to show dark space between distinct diffraction rings.

I took advantage of the 400x magnification to test the Ultima's ability to settle out vibrations. Celestron throws in vibration-dampening pads to place under the foot of each tripod leg which cut dampening times by at least 50%. Rap-induced vibrations on the Ultima 9¼ took about eight seconds to dampen out without the pads, compared to four seconds with the pads in place.

This isn't bad when you consider that the optical tube's back-angled center of gravity over the field tripod has a potential to set up some long-lasting vibrations.

Good Vibrations

For many, the fundamental reason for owning a compact optical system is portability, a benefit that shouldn't come at the expense of aperture, stability, drive versatility, and optical quality. The Ultima 9¼'s ability to meet these demands, all while introducing technical innovations like a built-in digital focus counter, sends a strong signal that you don't have to leave the mainstream commercial telescope market to find exceptional performance in a moderately-priced package.

In the balancing act between bulk versus capability, the Ultima 9¼ weighs in with everything an observer needs to reap the wide range of experiences a world of telescopic astronomy has to offer.

STANDARD SPECIFICATIONS

Aperture:
9.25 inches (235 mm)
Focal ratio: f/10
Focal length: 2,350 mm
Secondary Mirror Obstruction:
36% (by diameter)
Length of tube:
21⅝ inches
Size of focuser:
1.25 inches
Included 1.25-inch eyepiece:
26 mm (Plössl, 90x)
Photographic field:
0.59° by 0.88°
Weight of tube assembly and fork mount: 48 lbs
Weight of the Ultima wedge and field tripod:
33 lbs
Warranty:
one year, materials and workmanship
Suggested list price:
$3,998
Typical retail price:
$2,250
(Includes 6x30 finder, hand controller, adjustable field tripod, 1¼-inch star diagonal, and 26 mm Plössl eyepiece.)

Celestron International,
2835 Columbia Street,
Torrance, CA 90503; phone,
(310) 328-9560; fax, (310)
212-5835.

Available through
Celestron's dealer network.

ask Astro

A distinguished astronomer answers your questions

by James B. Kaler

The motivation to write an article based on readers' questions was deceptively simple. It would be fascinating to see what readers have gleaned from the pages of *Astronomy* and what misconceptions there might be. Many of the questions made me think of things in new ways and recall my own struggles to understand aspects of the subject. Of the more than 100 questions received, I chose those that I thought would have the broadest interest (they have been edited for brevity and clarity). Follow along as we start with the solar system and travel outward to the far reaches of the universe, guided by an interest in, and love of, astronomy and the natural world. We begin the story, however, not with a specific question on astronomy, but one that deals with science in general, asked by Richard Freeman of Waukesha, Wisconsin:

Q: Why (for example), based on computer calculations, will hundreds of astronomers scurry to find evidence for hypothetical brown dwarfs while ignoring thousands of pieces of evidence supporting the existence of UFOs? The scientific community reacts not by studying the objects described and photographed, but by questioning the mental stability of the observers, and demanding from them physical proof of UFOs. . . Is this the way good science works?

A: Yes, that is the way good science works. Science depends on the repeatability of experiment or observation and on a base of predictive theory. Discoveries — accidental or not — must be accessible to other methods of detection. Brown dwarfs are predicated on star formation theory and the existence of dim stars that lie just above the brown dwarf mass limit. They "should" be there and are in fact now being discovered. Their absence would be equally exciting because it would advance our understanding of how stars are born.

The evidence for UFOs being alien spacecraft, however, is suspect and is neither consistent nor repeatable. Photos and videos are easily faked and UFOs seem to be observed or observable only by select people. A brown dwarf photo could be faked too, but then you or I could take another picture to check if it was real of not. You cannot do that with a UFO. Evidence for UFOs is anecdotal and not systematically acquired, and there is no theoretical predictive base for their existence.

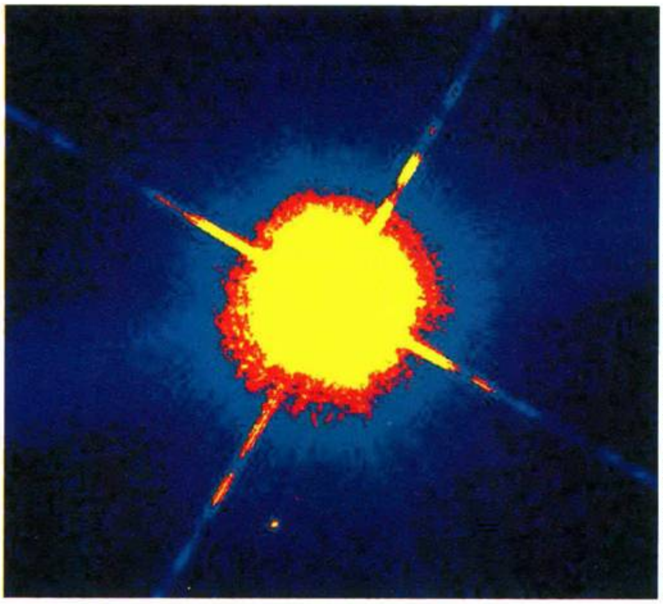
In fact, scientists have examined the evidence in a variety of studies, the Condon Report for one (which was commissioned by the U.S. Air Force in the 1960s), and they have accepted the findings. Scientists see no compelling reasons to reexamine the issue, as the evidence remains the same. UFO believers do not accept the findings and it is unlikely that any scientific report could convince them — an attitude that is antithetical to science.

The workings of science and its integrated nature are further illustrated by a question from Russell D. Schonmeier of Argyle, Minnesota:

Q: How are scientists able to determine that martian meteorites are from Mars, the age of the rocks, and how long ago they landed on Earth?

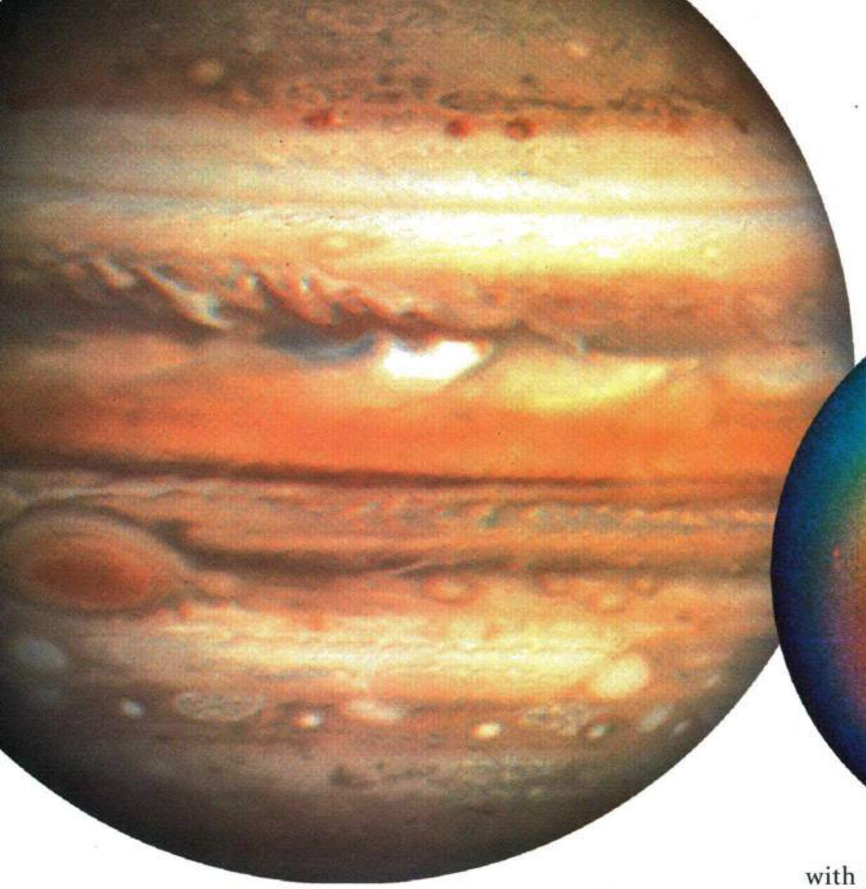
A: We have accepted that the meteorites are from Mars because they contain gases in the same ratios found in the martian atmosphere by the Viking landers. The rocks contain radioactive elements that decay at steady rates into lighter "daughter" elements. By comparing the amounts of daughter products to the amounts of the parents, we can tell how long it has been since the rock solidified. A meteorite impact later launches the rock into orbit around the sun. Interplanetary space is filled with high-speed atomic nuclei called cosmic rays. These particles penetrate the rock and leave scars, the number of which tells us the duration of the rock's travel time. The meteorite's time of residence on Earth can be found by dating the age of the surroundings in which it is found. The subject brings numerous scientific disciplines under one umbrella, all of which have been rigorously tested.

The violence that blasted the martian meteorite into space is commonplace in the solar system, as

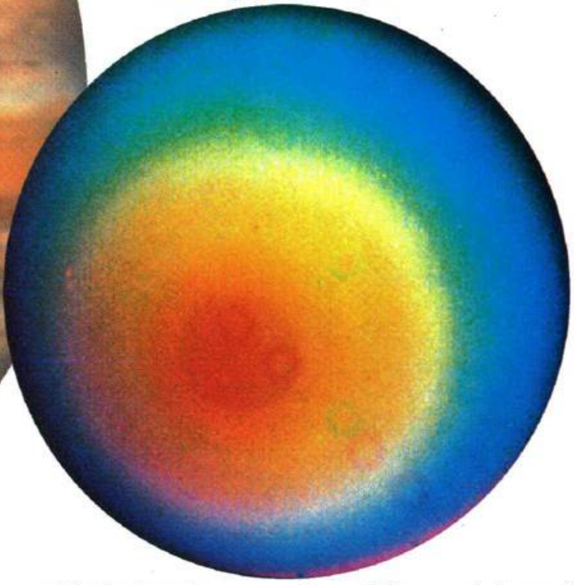

Shrinivas Kulkarni (Caltech), David Golimowski (Johns Hopkins Univ.), and NASA

This Hubble Space Telescope image shows the first confirmed brown dwarf, Gliese 229B (the little dot at the bottom). Unlike UFOs, the brown dwarf can be photographed again and again, proving it's for real.

This UFO was photographed in 1958. It was photographed only once and can never be photographed again, which makes it impossible to determine whether or not it was an alien spacecraft. Archive Photos/Popperfoto



Jupiter rotates in the same manner as Earth and most of the other planets, as indicated by the parallel bands in its atmosphere. If Jupiter were 80 times more massive, it would have ignited nuclear reactions in its core to become a star. USGS



Uranus's pole appears face-on in this false-color Voyager 2 image. The bull's-eye pattern illustrates the fact that Uranus rotates on its side. Astronomers think a large object crashed into Uranus when it was forming, literally knocking it over. NASA/JPL

supported by the answers to two other questions, the first from Edward Wetherbee of Hamden, Connecticut:

Q: How can a planet capture a satellite when an incoming body should go out with the same velocity with which it came in?

A: An interloper could collide with, and be slowed down by, a planet's natural satellites. That may explain how Triton, which orbits Neptune backwards, was captured, and why Neptune has fewer satellites than its twin Uranus. They may have been wiped out in the capture process.

Uranus itself testifies to collision, as queried by Candace Caligiuri of Winnipeg, Manitoba:

Q: Why is Uranus tilted on its side?

A: Uranus's rotation axis is tipped over by 98° and it rotates backwards relative to the general direction of motion in the solar system. We presume it was hit by something big while it was forming. These scenarios fit well with the idea that all the planets formed as smaller primitive bodies continually collided to make larger ones.

Most of the planets, including Jupiter, orbit with their spin axes oriented "up and down." Brian Bailey of Brookfield, Wisconsin, asks the following about Jupiter:

Q: Why is Jupiter not a star, and, alternatively, could it be considered a brown dwarf?

A: Although 318 times more massive than Earth, Jupiter would need 80 times more mass for its core to be hot enough to sustain thermonuclear fusion — the creation of helium from four atoms of hydrogen with the release of energy. Fusion generates the energy that allows stars to shine. Brown dwarfs are not massive enough to sustain fusion either. These "failed stars," however, form entirely from interstellar gas. Planets, on the other hand, assemble from the dust and gas of the remnant disk that forms while the star is accreting matter. The two classes may in fact overlap — as of now, we do not know.

Michael Bradtke of Chicago, Illinois, continues the theme:

Q: If the sun and the solar system formed from the same cloud, why is the percentage of hydrogen and helium so much greater in the sun than in the four inner planets?

A: The "solar nebula," the disk of dust and gas that bore the planets, was much hotter near the sun than it was out by Jupiter. Water, for example, boils at such a low temperature that the inner planets could not accumulate any (astronomers think comets brought water to Earth after the planet formed). The powerful gravity of the outer planets accreted hydrogen gas, but it was too hot in the inner solar system for the low-mass planets to retain hydrogen gas, which is the lightest element. Indeed, much of it may have been blown away by the young sun. Therefore, Earth and its kin consist of heavy materials that condense at high temperature: iron and silicates. The sun contains some of this heavy stuff too.

Don Johnson of Hazelwood, Missouri, asks:

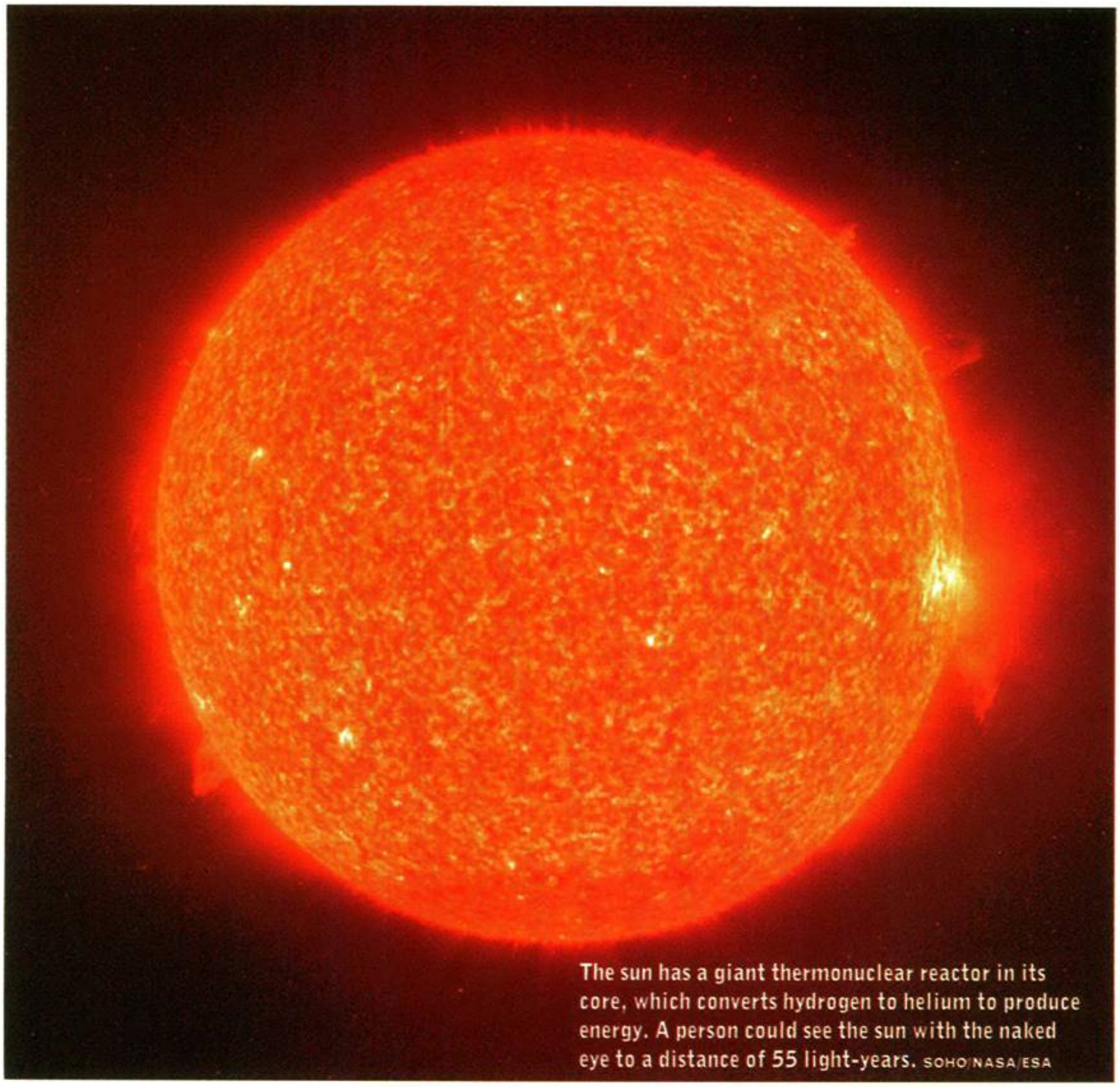
Q: The sun must have acquired many Earth masses worth of heavy elements during birth. Is there a deep inner core of the heavy stuff? How does it affect how the sun works?

A: By number of atoms, the outer solar layers are made of 92 percent hydrogen and 8 percent helium. Iron, silicon, and other heavier elements ("metals" in astronomy parlance) constitute only 0.1 percent, and these are mixed evenly throughout the sun rather than being concentrated in the core. The heavy elements make the solar atmosphere more opaque, influencing the flow of energy from the core and the overall solar structure and size. The lowered opacity within metal-poor stars (called "subdwarfs") makes them hotter and bluer than their metal-rich counterparts. The sun's core, however, where thermonuclear fusion generates more than 10^{26} watts of power, is growing rich in the by-product of fusion, helium.

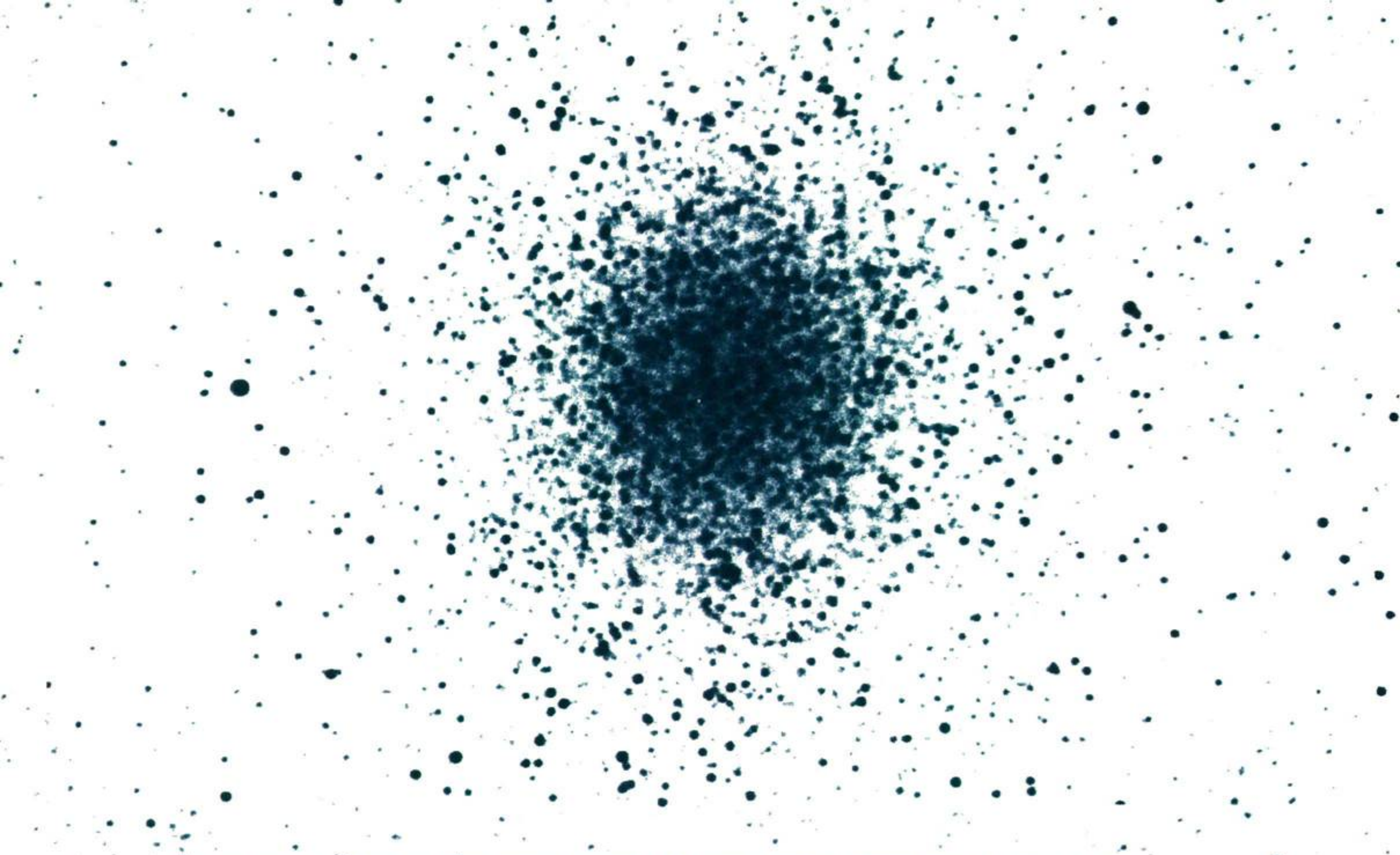
For all its enormous energy output, however, the sun is a modest star, as demonstrated by a question from Ted Wolfe of Naples, Florida:

Q: How far away would the sun have to be before it was no longer visible to the naked eye?

A: Assuming a dark sky and a person with normal eyesight who could see to magnitude 6.0, the sun would disappear from view at a distance of about 55 light-years. Such a figure gives one respect for other stars. Dubhe, the front bowl star of the Big Dipper, would have to be 600 light-years



The sun has a giant thermonuclear reactor in its core, which converts hydrogen to helium to produce energy. A person could see the sun with the naked eye to a distance of 55 light-years. SOHO/NASA/ESA



Globular clusters such as Omega Centauri are probably stripped of gas as they pass through the galactic plane. Jack Newton

away before it would disappear from naked-eye view. And Deneb, at the top of the Northern Cross, would have to be 14,000 light-years away!

Such distances make Adrian Darnaby of Durham, North Carolina, question the reality of what he sees:

Q: When we see stars, we see them as they were many years ago; does that mean that they may no longer exist?

A: For the most part, the ages of stars are huge compared with their distances. You don't see people as they are "now" either; you see your friend across a dinner table as she was 3 trillionths of a second ago, an insignificant period of time in her life. In the case of a massive star such as Betelgeuse that will someday explode as a supernova, Mr. Darnaby is correct: There is a slight possibility it may no longer exist, since its light takes about 1,000 years to get here.

Solar-type stars are not massive enough to explode. When the sun's nuclear fuel runs out 5 billion years from now, the core will shrink and heat, and will then fire its helium to fuse into carbon and oxygen. At the same time, the outer layers will expand to produce a red giant star that will wipe out Mercury and probably Venus. The sun will then lose its outer envelope through a fierce wind, producing a planetary nebula, and it will leave its carbon-oxygen core behind as a tiny white dwarf about the size of Earth.

David Stevenson, of Norwich, England, wants to know what happens to stars having more than one solar mass:

Q: Stars that have initial masses over 8 times that of the sun will make iron cores that collapse, causing the stars to explode. What happens in stellar cores that have initial masses between the sun and this limit?

A: A more current estimate is that stars above about 11 solar masses develop iron cores through advanced nuclear fusion. From 1 solar mass to about 8 or so, the carbon-oxygen cores simply grow more massive. Then from about 8 to 11 solar masses, stellar cores can fuse carbon and oxygen into still heavier elements. These stars die as rather rare neon-magnesium white dwarfs (most white dwarfs are dominated by carbon). Although fusion proceeds through silicon and sulfur, it comes to an end when the core is made of iron. The star is then ready to go supernova.

The sun will live for more than 10 billion years before it enters the white dwarf state. The stars of globular clusters are even older, the best estimates coming in around 14 billion years. This leads Ron Kohl of Lakewood, New York, to wonder:

Q: If globular cluster stars are continually dying and losing mass, why do the clusters have so little gas within them?

A: A lot of astronomers wonder about that too. Most likely the clusters are stripped of their gas when (as they orbit the galactic center) they pass through the disk of our galaxy and hit the disk's dense interstellar medium. But as yet there seems to be no definitive answer.

Galaxies can also pass through other galaxies. Todd Bustillo of Cypress, California, asks:

Q: What effect would colliding galaxies have on the life on planets within those galaxies?

A: The stars are so far apart that even during the galactic collision they would miss each other, so there would be no harmful effect on any "Earths."

As part of our "Local Group," the Andromeda Galaxy, 2.4 million light-years away, is gravitationally locked to the Milky Way (and is approaching us at about 60 kilometers per second), making Thomas Peterson of Princeton Junction, New Jersey, ponder:

Q: If the Milky Way and Andromeda galaxies were orbiting each other, how many times would we have circled?

A: From the masses of the galaxies and their distances apart, Kepler's laws tell us that the orbital period is at least 30 billion years, far longer than the age of the universe. This figure vividly illustrates the vast distances involved. Computer models show only small relative movement between the galaxies since they were both born.

A major discovery of the past 20 years involves the distribution of galaxies. Once thought to be simply arranged in clusters, they are now seen to form some sort of highly irregular froth, the clusters linked in great streams that encompass vast voids millions of light-years across. We do not know why. Jim Roberts of Ridgefield, Connecticut, wonders:

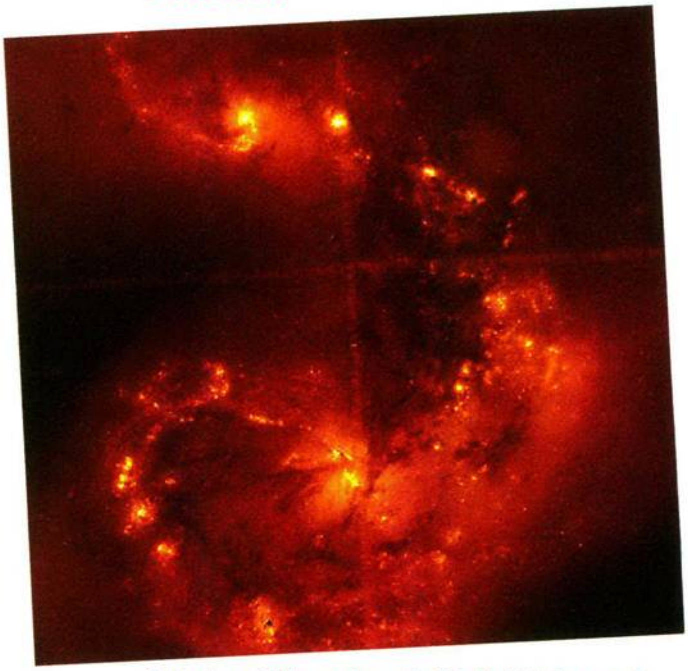
Q: Is there a volume over which the galaxies smooth out?

A: There is evidence from the radio emission of faint galaxies and from the distribution of faint blue galaxies that the distribution is indeed smooth at very large distances, but astronomers have not yet found over what distance that actually occurs. So, sorry, there is no answer as yet, and we see science at the edge of discovery.

Whatever the answer, there is little question about the expansion of the universe, a property derived from direct observation and predicted by theory. As we look out to more distant galaxies, their spectra are increasingly shifted to the red. The phenomenon is commonly ascribed to a Doppler shift, wherein a wavelength is increased if a body is moving away from you and decreased if it is moving toward you. The redshift of distant galaxies, however, is not caused by a Doppler shift, but rather by the expansion of space itself, in which the galaxies "float" (and move on their own, superimposing real Doppler shifts). The rules are therefore not the same as they are for a simple Doppler shift.

These concepts are so strange that Greg Goellner of Bloomingdale, New Jersey, wondered:

Q: How can we see a galaxy 12 billion light-years away when the expansion of the universe is only 10 percent the speed of light, so that they could be no farther apart than 10 percent the age of the universe?



Galaxies collide, as shown in this Hubble image of NGC 4567/8, but their individual stars do not because they are spaced so far apart. STScI and NASA

A: The universe has no fixed expansion speed. The speed you see depends on distance. The expansion rate — known as the Hubble constant — is currently measured at about 75 kilometers per second per megaparsec (one megaparsec equals 3.26 million light-years). As the distance increases, so does the expansion rate. Within the confines of our

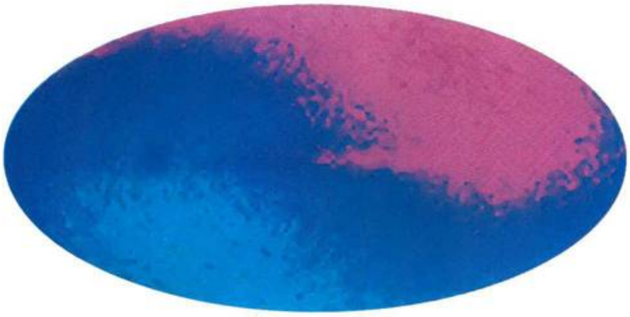
Tony and Daphne Hallas

The Andromeda Galaxy, shown here, and the Milky Way are the two largest galaxies in the Local Group. The Andromeda Galaxy is approaching us at a speed of about 60 kilometers per second (135,000 miles per hour).

100,000-light-year-wide galaxy, the expansion speed of one side relative to the other is only 2 kilometers per second, far less than the speeds of stars, so small that gravity overwhelms the expansion. Only over intergalactic distances does the expansion become important. A galaxy 100 million light-years away is moving at a speed of 2,300 kilometers per second, and one 5 billion light-years away is moving at 115,000 kilometers per second, 38 percent the speed of light. This leads to the question, asked by John Landreth of Chapel Hill, North Carolina:

Q: Can anything in the universe move faster than light?

A: The standard answer is "no." Relativity tells us that it would require an infinite amount of energy to accelerate a body to the speed of light, and therefore nothing can be accelerated to a higher velocity. However, this rule applies only to bodies moving through space, not to space itself. At a distance of 13 billion light-years, the speed of expansion relative to Earth hits the speed of light. Beyond that distance, the observed universe can actually be expanding faster than light, because it is space that is expanding, not the things within it.



The cosmic microwave background is the "echo" of the Big Bang, filling space everywhere. The microwave background appears slightly hotter in one direction (shown as blue) due to Earth's motion through space. NASA

Is the redshift caused only by expansion? David Morris of Las Cruces, New Mexico, asks:

Q: Is it possible that the redshift is due in part to a loss of photon energy as a result of interaction with the contents of space?

A: No. Interactions might destroy individual photons, but they would not cause any photons to lose energy. The redshift lengthens the wavelengths of all photons. As is mass, light is also caught in the web of space. As space expands, so do photons as they fly from distant galaxies to us: They are thus stretched along with expanding space. The longer they take to get to us, the more they are redshifted, a phenomenon very different from a Doppler shift, which has its own rules.

The expansion has the same effect on the cosmic background radiation, explored here by Raju Palnitkar of Cromwell, Connecticut:

Q: Did the background radiation originate at the beginning of the universe or does space still continue to radiate like a 3 kelvin blackbody?

A: Yes and yes. The background radiation originated about 300,000 years after the Big Bang. The universe apparently began in a hot dense state, with a temperature higher than 10^{30} K. Since photons created in the Big Bang are "trapped" in space, they too stretch with the expansion of the universe. Fifteen billion years after the Big Bang, the once-"hot" photons have stretched and "cooled" to a temperature of only 3 K. When we look out to great distances, and therefore look back in time, we can see to the epoch when the background radiation was hotter.

Carl Mante of New Windsor, New York, Richard Burgess of Carrollton, Texas, Steven Darnell of Silver Spring, Maryland, and Leon Busby of Rancho Palos Verdes, California, asked similar questions which are best to combine:

The arrow points to one of the most distant known objects in the universe, a proto-galaxy about 10 billion light-years away. We see it as it existed 10 billion years ago. Ken Lanzetta and Amos Yahil (SUNY at Stony Brook) and NASA

Q: As we look out into space, we see objects as they were, and we see the universe as it was billions of years ago. Only now does light-travel-time become significant. How do we see light from such a young universe? If the universe was small at the time of its creation, why does it appear larger as we peer further back in time? Where did the expansion begin and what is its shape?

A: The Big Bang did not happen in some central place, or "out there"; it happened everywhere, here included, and we are surrounded by a cooled fireball trapped within a universe that seems to have a similar expansion in all directions. If we look at a quasar 8 billion light-years away, we see it as it was 8 billion years ago. The quasar must then be seen as it was not long after the Big Bang, when it was young. The universe was not necessarily "small" when it was young, just hot and dense, its mass and energy "closer together." The universe has simply been expanding at an ever-decreasing rate over all that time because of gravity. The quasar's light, trapped in the fabric of expanding space, has been traveling toward us as the quasar itself moves away and has now just reached us. Despite the expansion, however, the quasar's light still hits us at the speed of light, a basic fact requiring the theory of relativity to resolve.

Astronomy thanks the hundreds of readers who submitted questions for this article. Starting with the August issue, _Astronomy_ will be running a monthly question-and-answer column. We welcome questions pertaining to both the science and hobby of astronomy. Send your question via e-mail to: askastro@astronomy.com; or write to: Ask Astro, P.O. Box 1612, Waukesha, WI 53186. Please include your full name and place of residence. _Astronomy_ regrets that due to the large volume of mail, we are unable to publish answers to all questions or respond to each one individually.

Finally, let us return back to science and its nature with a question asked by Richard Murphy of Waianaie, Hawaii:

Q: Why do astronomers believe so fanatically in the Big Bang in view of a variety of other "theories" that have fallen by the wayside? Isn't holding on to fanatical beliefs a hindrance to science rather than a tool?

A: Scientific theories are not belief systems. They are models that attempt to explain the observations. Astronomers have adopted the Big Bang because it is the theory that comes closest to actually explaining what we see. It is not perfect, and it is clearly incomplete. However, it explains the expansion of the universe, and its mathematical details correctly predict the observed current temperature of the Big Bang fireball, the observed abundances of the light elements, and a variety of other observed parameters. Other theories do not. For now, the Big Bang stands tall — but watch this space. ▣

James B. Kaler studies stellar evolution at the University of Illinois at Urbana-Champaign. He has written numerous books on astronomy, including The Ever-Changing Sky *and* Stars. *His latest book is* Cosmic Clouds, *which is part of the Scientific American Library.*

TELESCOPE & BINOCULAR CENTER™

America's Largest Catalog of Telescopes, Binoculars, and Accessories for Amateur Astronomers—Since 1975!

WITH TELESCOPE PURCHASE

ORION
Where The Stars Are
Where The Stars Are
Astronomy CD-ROM

Special Limited-Time Offer

Where the Stars Are™ Astronomy CD-ROM
An $89 Value—FREE with purchase of any Orion astronomical telescope!

The perfect guide to the sky for new telescope owners!

Requires PC running Windows 95 or 3.1x operating system.

TELESCOPES

CELESTRON

Celestar 8 Deluxe Schmidt-Cass

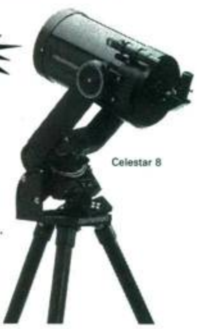
NEW!

This turbocharged Celestar 8 has a heavier fork mount and a worm-gear drive with PEC. Other enhancements include both R.A. and Dec. motors and hand controller, making it ideal for astrophotography. Also a big 9x50 finder scope, 26mm (78x) Plössl eyepiece (1.25"), star diagonal, equatorial wedge, and heavy-duty aluminum tripod. 2032 f.l., f/10.
CALL

Celestar 8 Deluxe Computerized

NEW!

Same as the Celestar Deluxe but with the Advanced Astro Master computerized pointing system with 10,000-object database. Perfect for the astronomer who wants it all!
CALL


Celestar 8

Celestar 8

Terrific value! Clock-driven 8" f/10 Schmidt-Cass comes complete with high-transmission Starbright coatings, wedgepod, 6x30 finder, star diagonal, and 25mm (81x) SMA eyepiece (1.25").
$1099

Celestar 8 Computerized

$1699

Optional Hand Controller for Celestar 8 $79

Fastar 8 CCD-Optimized Schmidt-Cass

NEW!

Innovative design allows superfast f/1.95 CCD imaging. For use with Celestron PixCel 255 CCD System (sold separately), but also ideal for visual observation at f/10 without the CCD. Fully outfitted.
CALL

PixCel 255 CCD System
Enter the exciting world of CCD imaging. PixCel 255 makes it easy. Includes CCD camera head, CPU box, software, and AC adapter.
CALL

C5+ Schmidt-Cass

Super-portable and highly versatile, this 5"-aperture telescope excels for visual observation and astrophotography. Built-in R.A. drive, equatorial wedge, 6x30 finder, diagonal, and 25mm (50x) eyepiece (1.25"). 1250 f.l., f/10. Tripod optional.
CALL

Field Tripod for C5+	$289
Declination Motor for C5+	$124
Hand Controller	$77
Hard Case	$239

More Celestron Scopes:

Ultima 2000 8"	CALL	**Star Hopper 4.5" Refl.**	CALL
GP-C8	CALL	**Star Hopper 6" Dob**	CALL
Ultima 9-1/4	CALL	**Star Hopper 8" Dob**	CALL
Ultima 11	CALL	**GP 102mm EQ Refractor**	CALL
CG 9-1/4	CALL	**Firstscope 60 EQ Deluxe**	CALL
CG 11	CALL	**Firstscope 76 EQ Refl.**	CALL
CG 14	CALL	**Firstscope 80 Altazimuth**	CALL
C4.5 EQ Reflector	CALL	**Firstscope 80 EQ**	CALL
		Firstscope 114 Dlx. EQ	CALL

ORION

Argonaut™ 150mm Maksutov-Cassegrain

NEW!

The design heralded for its extraordinary image quality is now very affordable. Effective focal length is 1800mm (f/12), 150mm (nearly 6") aperture. Includes tube assembly with gearless Crayford 2" focuser, 7x35 achromatic finder, 1/4"-20 plate, and deluxe case.
$999

Argonaut 150 shown with optional star diagonal and eyepiece. Mount sold separately.

Deep Space Explorer™ Dobs

NEW Enhanced Features!

The Dobs *S&T* called a "best buy" are now an even better value! New rack-and-pinion focuser, four-vane secondary mirror support for more precise collimation, larger handle on the Dobsonian base, and black tube finish. Standard accessories include a 25mm Explorer II eyepiece (1.25") and 5x finder scope. Bonus Accessory Package available.

6" (f/8), 8" (f/6), 10" (f/4.5)
From $359

Premium Deep Space Explorer™ Dobs

The ultimate large-aperture scopes for deep-sky devotees. Hand-figured, diffraction-limited Pyrex optics with enhanced 94%-reflectivity coatings for brighter images. Includes 26mm Sirius Plössl eyepiece (1.25") and choice of focuser.

10" (f/5.6), 12.5" (f/4.8), and 16" (f/4.5) From $799

ShortTube™ 80mm Rich-Field Refractor

Rich-field 400mm f.l., f/5 scope that's great for observing and prime-focus astrophotography. 6x30 finder, 1.25" rack-and-pinion focuser, 45° erect-image diagonal, and TWO 1.25" Kellner eyepieces. Attaches to any photo tripod or to Orion equatorial mount (sold separately). Optional carrying bag available.
$249

ShortTube 80mm shown on optional equatorial mount.

More Orion Scopes:

VX 80mm Altazimuth Refractor	$539
Observer 80mm EQ Ultra Refractor	$319
Observer 60mm Altazimuth	~~$139~~ SALE $119
Observer 60mm Altazimuth Ultra	$169
Observer 60mm EQ	$169
Observer 60mm EQ Ultra	$239
ShortTube 4.5" EQ Reflector	$249
ShortTube 4.5" EQ Ultra	$379
SpaceProbe 4.5" EQ Reflector	$279
SpaceProbe 3" Altazimuth Reflector	$119

Our 22nd Year!

Tele Vue

NEW!

Tele Vue 101

Al Nagler's latest 4"-aperture fluorite refractor offers incredible resolution and contrast, with virtually no color fringing. Focal length is 540mm, f/5.4. Ivory finish. Includes 20mm Plössl eyepiece (1.25") and case. Mount and tripod sold separately.
CALL

Ranger 70mm Refractor

The highly portable Ranger goes where you go. It combines a 70mm ED-glass achromatic objective and 480mm focal length (f/6.8) with a rugged, all-metal body. Includes helical focuser, mirror diagonal, and 20mm (24x) Plössl eyepiece (1.25").

Ivory Tube	$649
Brass Tube	$775
Field Flattener	$99
Camera Adapter	$43.50

NEW!
Field Flattener & Camera Adapter

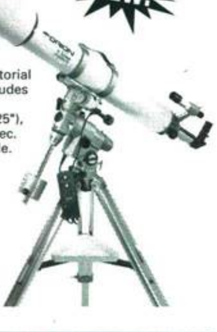
More Tele Vue Scopes:

Genesis 4" SDF Fluorite Refractor	CALL
Renaissance 4" SDF Fluorite Refractor	CALL
Pronto 70mm Refractor	CALL

ORION

VX 102mm GP Equatorial Refractors

NEW!



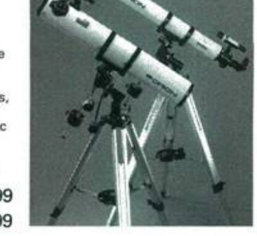
Manufactured for Orion by Vixen, these dream refractors deliver heavenly views of the planets, Moon, and beyond. Absolutely impeccable imaging performance. Precision Great Polaris equatorial mount is an engineering masterpiece. Includes 6x30 finder, polar alignment scope, prism diagonal, 26mm Sirius Plössl eyepiece (1.25"), and aluminum tripod. Optional R.A. and Dec. motor drives and hand controllers available.

Standard Model
1000mm f.l., f/9.8 $1199

Fluorite Model
920mm f.l., f/9.0 $2299

SkySensor 2000 Auto-Pointer
(includes motor drives) $985

SkyView™ Equatorial Telescopes



High-performance telescopes for the more serious beginner. Advanced optics, German-type equatorial mount with dual slow-motion cables, and stable aluminum tripod. Accessories include 6x30 achromatic finder scope, prism star diagonal (refractor only), and TWO 1.25" Kellner eyepieces: 25mm and 9mm.

4.5" (114mm) Reflector	$399
90mm Refractor	$599

MONEY-BACK GUARANTEE
100% Satisfaction
If you are not completely satisfied with your purchase from the Telescope & Binocular Center for any reason, just return it in new condition within 30 days after delivery for a prompt refund.

Visit one of our California Retail Stores!
Some prices in retail stores may vary.

San Francisco • 3609 Buchanan St., at Bay, 1 block from Marina Safeway • (415) 931-9966
San Jose-Cupertino • 10555 S. De Anza Blvd., at McClellan: from Hwy 280, take De Anza exit; from Hwy 85 take De Anza or Stevens Creek exit • (408) 255-8770
Monterey Bay-Watsonville • 89 Hangar Way, off Airport Blvd. near Santa Cruz • (408) 763-7000

ORDERS/FREE CATALOG: (800) 447-1001
INFORMATION/ADVICE: (408) 763-7030
HOURS: M–F 6AM–10PM, SAT. 8am–6pm PACIFIC TIME

www.oriontel.com

BINOCULARS

ORION

MINI GIANT™ 8x56 & 9x63

These high-quality binoculars will provide grand views, offering excellent light-gathering power, moderate magnification, and generous field of view.

Mini Giant binoculars bridge the gap between traditional 50mm "night glasses" and 70mm and 80mm "giant" models. BAK-4 porro prisms, fully multi-coated optics deliver the highest light transmission and contrast. Threaded for tripod mounting.

8x56, 9x63 From $199

Nikon

Wolverine 7x50

The maker of fine camera equipment also produces a fantastic binocular. Multi-coated optics and BAK-4 glass porro prisms provide camera-sharp images rich in contrast. A great choice for scanning the Milky Way for buried treasures. 16mm eye relief, rubber armor. $204

PENTAX

PCF III

Long 20mm eye relief is only the beginning of the desirable features of the PCF III. Multicoated optics serve up bright, crisp views. Focus lock mechanism, click-stop diopter adjustment, and modern styling too. Tripod adaptable.

7x50, 10x50 $179

FUJINON

SALE!

Polaris 7x50

Fully EBC multi-coated optics and BAK-4 prisms yield extremely high 95% light transmission, a very flat image plane, and long 23mm eye relief. 100% waterproof! Tripod adaptable.

7x50 FMTR-SX	~~$599~~	$469
7x50 FMT-SX	~~$549~~	$429

FUJINON

SALE!

Polaris 70mm

Awesome Astro Binos

Flat-field optics reduce distortion and astigmatism to virtually undetectable levels. BAK-4 prisms and EBC multi-coatings. Waterproof, tripod adaptable.

10x70	~~$675~~	$529
16x70	~~$699~~	$559

CELESTRON

BRIGHT IMAGES!

Ultima® Series

Long 21mm Eye Relief

Scanning the night sky is a treat with these top-quality binos. Fully multi-coated, BAK-4 prisms. Tripod adaptable.

7x50, 10x50, 8x56, 9x63 From $259

CELESTRON

WATER RESISTANT!

Pro Series

A popular choice for those who want a better binocular at a reasonable price. Fully multi-coated optics with BAK-4 prisms deliver high contrast and clarity. Water-resistant covering with inlaid grip grooves. Tripod adaptable.

7x50, 10x50, 8x56 From $169

ORION

EXTRA-LONG EYE RELIEF!

UltraView™ 50mm

Best Bino Available For Eyeglass Wearers

Extra-long 22mm eye relief and unique pop-down eyeguards. Fully multi-coated. BAK-4 prisms. Tripod adaptable.

7x50, 10x50 WA $188

ORION

FULLY MULTI-COATED OPTICS!

Vista™ 50mm

Featherlight High-Performance Binoculars

High-index BAK-4 prisms and fully multi-coated optics for high-fidelity images. Soft leatherette covering. Tripod adaptable.

7x50, 10x50 $239

ORION

Big Binocs

All feature the finest fully multi-coated optics and BAK-4 prisms for brightest, sharpest images. All include tripod adapter.

Little Giant 10x70	$369
Little Giant 14x70	$369
Giant 11x80	$469
Giant 16x80	$469
Giant 20x80	$469
SuperGiant 14x100	$1299
SuperGiant 25x100	$1299

ORION

Scenix 7x50	$96
Scenix 10x50 WA	$96
Explorer 7x50	$147
Explorer 10x50	$147

Many more binoculars in our print and online catalogs!

EYEPIECES & ACCESSORIES

Sirius™

Sirius Plössl

You could pay twice the price for other brands of Plössl eyepieces, but why? Sirius Plössls are top-quality, 50° apparent-field (43° 40mm) eyepieces that yield extremely sharp images of impressively high contrast. Ideal for all types of telescopes. The fully-coated optics, rubber eyeguards. Stock up today!

1.25"

7.5mm, 10mm, 12.5mm, 17mm, 20mm, 26mm	$49.95 each
32mm, 40mm	$59.95 each

.965"

7.5mm, 10mm, 12.5mm, 17mm, 20mm, 26mm	$49.95 each

ORION

Ultrascopic™

The highest contrast and light transmission obtainable. Superior 5- or 7-element design with Ultra Multi-Coatings™ on every surface. Wide 52° apparent field. Removable winged rubber eyeguard. Threaded for filters. 1.25" barrels.

3.8mm, 5mm, 7.5mm, 10mm, 15mm, 20mm, 25mm, 30mm, 35mm

From $79

Explorer II

Attractively priced for even limited budgets. Their 3- and 4-element fully coated glass lens configurations provide a 50° apparent field of view. Threaded for filters.

.965" Explorer II

6mm, 10mm, 13mm, 17mm, 25mm

$34.95 each

1.25" Explorer II

6mm, 10mm, 13mm, 17mm, 25mm

$29.95 each

Illuminated Reticles, wireless

12mm Kellner	$99
12.5mm Plössl	$139
9mm Orthoscopic	$159

CELESTRON

Ultima Series

Fully multi-coated Ultima 1.25" eyepieces feature 4 to 7 lens elements with blackened edges. All are threaded for filters, have rubber grip rings and rubber eyecups.

5mm, 7.5mm, 12.5mm, 18mm, 24mm, 30mm, 35mm, 42mm

From $78

6.5mm–18mm Zoom (1.25")	$169
Micro Guide Illum. Reticle	$189
Pulstar Reticle Blinker	$69

Vixen Lanthanum

Long 20mm eye relief makes them ideal for eyeglass wearers. Apparent field 50° (9mm-15mm) or 45° (2.5mm-6mm). 1.25" barrels.

2.5mm, 4mm, 5mm, 6mm, 9mm, 10mm, 12mm, 15mm, 8-24mm zoom From $134

PENTAX

SMC XL Series

Their 5- to 7-element lens configuration yields a luxurious 65° apparent field. Super-Multi-Coated (SMC) with long 22mm eye relief. Retracting glare shield. All have 1.25" barrels except 40mm (2").

5.2mm, 7mm, 10.5mm, 14mm, 21mm, 28mm, 40mm From $279

Barlow Lenses

Celestron Ultima 2x (1.25")
Orion Deluxe 2x (.965", 1.25", 2")
Orion Shorty (.965", 1.25")
Orion VariPower (1.25")
Tele Vue 2x (1.25")
Tele Vue 3x (1.25")
TeleVue Big Barlow (2")

From $39.95

Tele Vue

Plössl

Fully multi-coated, 50° apparent field (43° for 40mm). All have 1.25" barrels except 55mm (2").

8mm, 11mm, 15mm, 20mm, 25mm, 32mm, 40mm, 55mm

From $85

Panoptic

Six-element oculars with wide apparent field of 68° and long eye relief. Multicoatings.

15mm (1.25"), 19mm (1.25"), 22mm (1.25"/2"), 27mm (2"), 35mm (2")

From $219

Nagler/Nagler 2

Dramatic 82° apparent field with full-field correction for pinpoint images edge to edge.

4.8mm (1.25"), 7mm (1.25"), 9mm (1.25"/2"), 12mm (1.25"/2"), 13mm (1.25"/2"), 16mm (1.25"/2"), 20mm (2")

From $189

ORION

Sky Wizard Electronic Finder & Sky Catalog

Spend your time viewing celestial objects instead of hunting for them! Sky Wizard tells you right where to point your scope. Incredibly easy to use and works with any telescope, equatorial or altazimuth. Requires installation kit, sold separately.

Sky Wizard Model 1	$179
Sky Wizard Model 2	$249
Sky Wizard Model 3	$349

Optics Cleaning

6-Piece Optics Cleaning Kit	$12.95
Celestron LensPen	$9.95
Miracle Microstar Cloth	$4.95

Filters

Lunar (.965", 1.25")	$15.95
SkyGlow Broadband LP	From $44.95
UltraBlock Narrowband LP	From $79.95

Full-Aperture Solar Filters

Many different sizes in stock. From $59.95

Color Filters

Sold individually or in sets. CALL

Dew Prevention

Dew Zapper

Electrical contact heater keeps dew from forming. Sizes to fit popular Schmidt-Cassegrains. DC and AC models. From $47.95

FlexiShield Dew Caps

Won't chip, crack, or break. Many sizes. From $29.50

Finder Scopes/Reflex Sights

EZ Finder Reflex Sight NEW MODEL	$39.95
Telrad Reflex Sight	CALL
6x30 Achromatic	$44.95
8x50 Nonilluminated	$79.95
8x50 Illuminated	$119
Dual-Ring Bracket for 8x50	$34.95

Flashlights

Orion RedBeam LED	$11.95
Celestron LED	$21.95
Starlite LED Adjustable	$24.95
Nitewriter Pen	$10.95
Twister Fexible	$19.95

Power

Rechargeable DC Field Battery	$64.95
Multi-Function Power Supply	$59.95
50-Watt Inverter	$39.95
140-Watt Inverter	$59.95
300-Watt Inverter	$99.95

Cases

Small Accessory Case	$19.95
Medium Accessory Case	$27.95
Large Accessory Case	$42.50

Soft Cases for Telescopes

For many different models From $38.95

Photographic

T-Rings. For many camera models.	From $14.95
T-Adapters	From $26.95
Photographic Film. Many types.	From $4.49
Orion UltraGuider Off-Axis Guider	$129
Celestron Radial Guider	$124

DeepMap 600

NEW!

Tired of looking at the same old objects? This quick-reference, full-color, folding star map shows where to locate 600 of the finest objects in the northern heavens with a backyard telescope. Visual data and description for every object. Printed on waterproof plastic to last forever! $12.95

Celestron f/6.3 Reducer/Corrector

CALL

Motor Drives

AccuTrack DC Motor Drive for SkyView Equatorial Mount	$89
AC Motor Drive	$84.95
R.A. Motor w/ Hand Controller	$219
Optional Dec Motor	$89.95
Polaris R.A./Dec. Motors w/ Controller	$399
Vixen GP R.A./Dec. Motor	$99
Vixen Single-Axis Controller	$119
Vixen Dual-Axis Controller	$199

We also carry a huge selection of observing books, star atlases, astronomy software, fun T-shirts, telescope-making components, and much more!

TELESCOPE & BINOCULAR CENTER
Our 22nd Year!
NEW TELESCOPES GALORE!
ORION
The Best Dobs Just Got Even Better!
NEW!
LIMITED-TIME OFFER
FREE!

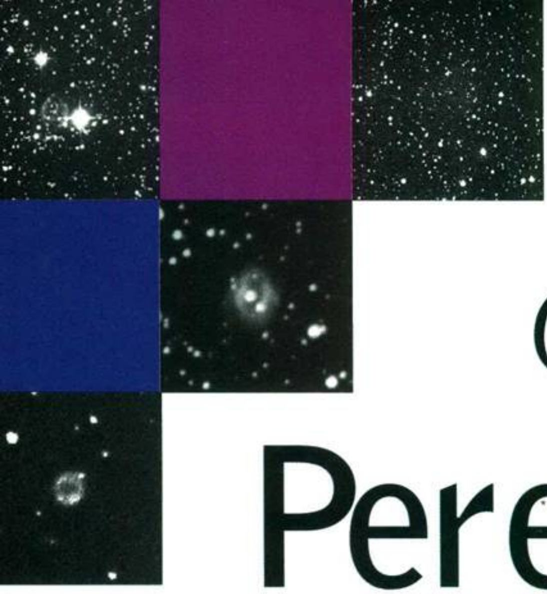
IT'S EASY TO ORDER!

- Call toll-free and charge to your Discover/Novus, MasterCard, or VISA Card, or send your personal check to order by mail.
- California residents add 7.25% sales tax (7.75% in Santa Clara County; 8% in Santa Cruz County, 8.5% in San Francisco).
- Shipping and handling charges for UPS Ground or US Mail to lower 48 United States are additional.
- Call for rates to Alaska, Hawaii, Canada or elseware. Expedited delivery available.
- Prices are subject to change or correction without notice.

MasterCard
DISCOVER NOVUS
VISA

When ordering, mention key code PMA

FREE 100-PAGE CATALOG
CALL (800) 447-1001
FULL ONLINE CATALOG
www.oriontel.com



Observing the Perek-Kohoutek Planetaries

Some planetary nebulae are not for the faint-hearted, but the rewards of finding them are worth the search.

by Tom Johnston

FEW THINGS IN LIFE ARE AS cataclysmic as the death of a star. Massive stars that produce supernovae are rare, while the processes that create planetary nebulae are more common. When a star of moderate mass like our sun reaches the end of the line, the hydrogen fuel at its core has been completely converted to helium.

With this energy source gone, the core begins to contract, releasing gravitational energy. This heats the core and its surroundings, creating a shell of intense hydrogen burning around the core that pushes the overlying layers outward to form an immense outer atmosphere — a red giant.

Eventually, the star "puffs off" the distended outer layers, which expand outward at speeds of as much as 20 miles per second. Left behind is the hot core of the star, which glows at a temperature as high as 100,000 kelvins and bathes the surrounding area with ultraviolet radiation. The expanding shell of gas absorbs the radiation and re-emits it as visible light, creating the bubbles and shells we see in planetary nebulae.

Some planetary nebulae are large and bright, like Vulpecula's Dumbbell Nebula (M27), while others are small and bright, like the Eskimo Nebula (NGC 2392) in Gemini. Others are so faint they were discovered photographically, but even these can be seen with a modest telescope.

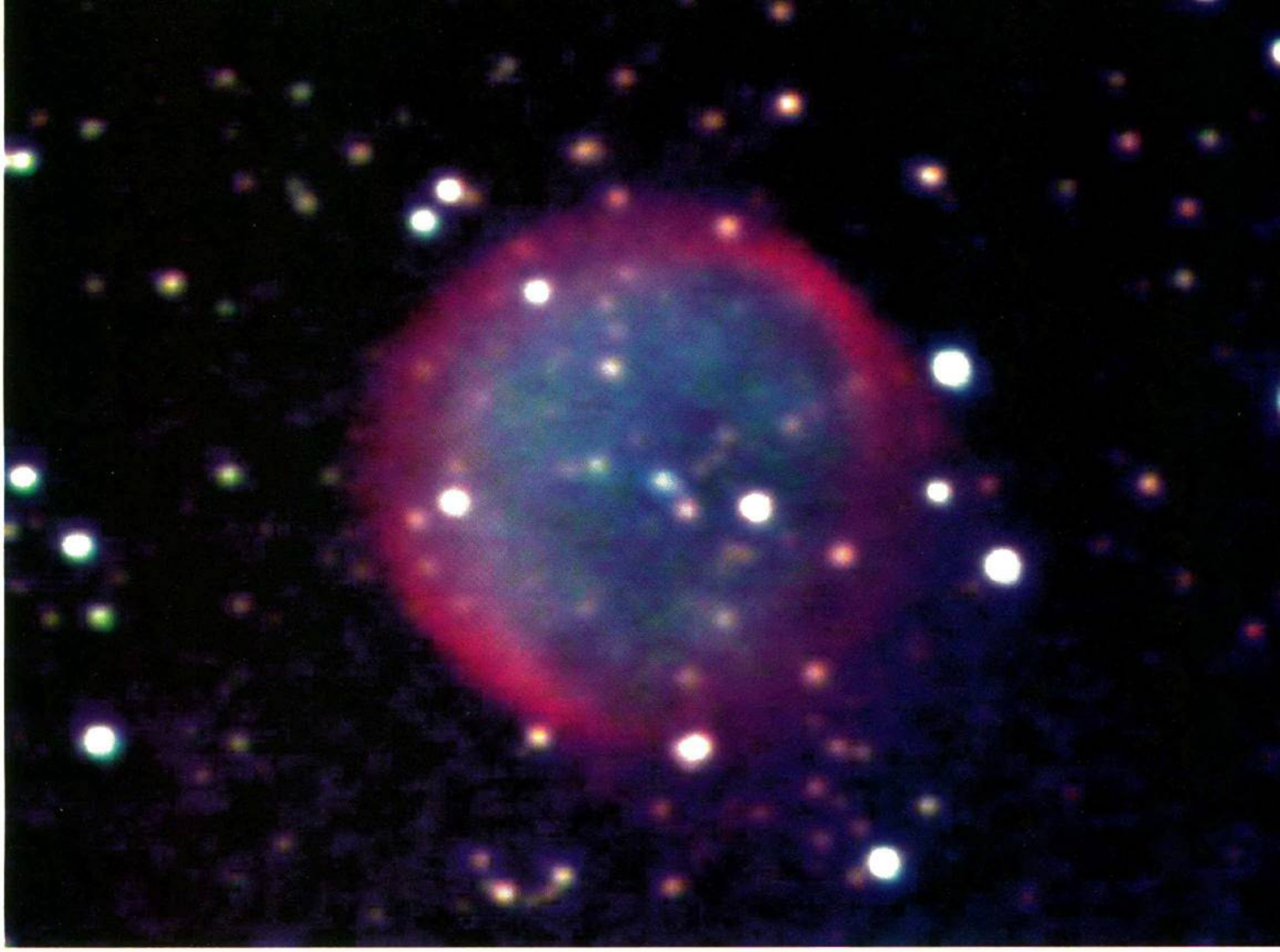
Until 1967, astronomers attempting to observe faint planetary nebula were hampered by the lack of a good reference catalog.

This changed with the publication of the *Catalogue of Galactic Planetary Nebulae* (276 pages + 115 plates, Academia, Prague, 1967) by Lubos Perek (Academy of Sciences of the Czech Republic) and Lubos Kohoutek (Hamburg Observatory, West Germany). It contains 1,036 entries covering all discoveries up to 1965. The P-K catalog, as it's often called, remains the standard reference for planetary nebulae observers and encompasses both the famous and the obscure.

Take a look at map 377 of *Uranometria 2000.0, Volume II*. The dominant deep-sky objects on the page (excluding stars, of course) are the 73 P-K planetary nebulae. I had always wondered whether these planetaries were worth the effort to track down when so many other wonderful sights are easier to capture. Furthermore, were they visible at all with a modest scope? I answered my own questions a few years ago while observing in the pristine skies of Luna Lake, Arizona. I was prowling around deep in the southern Milky Way when suddenly page 377 jumped out. Some of these must be visible in a 13-inch reflector! I tracked down P-K 355–04.1 and P-K 356–04.2, both near the sprawling open cluster M7. In the eyepiece, P-Ks are nothing to write home about, but if you successfully log a few, you enter a select group of observers who have accomplished it.

These planetaries appear similar in the eyepiece — small and essentially round. Medium to high powers (150x and above) will be needed to identify the planetary disks from the surrounding stars. Don't forget your UHC or OIII nebula filter. These filters increase

Upper left: All photos by Martin Germano



Al Kelly

This tricolor image of P-K 41–2.1 (NGC 6781) shows the planetary nebula's expanding bubble of gas. Facing page, clockwise from left: P-K 59–18.1, P-K 77+14.1, P-K 103+0.1, and P-K 79+5.1.

the contrast between the sky and the nebula; three nebulae, P-K 59–18.1, P-K 72–17.1, and P-K 81–14.1 are hard to see without one.

The accompanying chart shows 10 P-K objects. A good atlas will help you get to your quarry. Be prepared to observe some objects that lie at the edge of perceptibility, but do not let this warning deter you from the quest. Planetaries usually have high surface brightnesses, and this is true with the P-Ks. This makes them viewable, once you've found them. Go to a dark site, use averted vision, and be patient. With each entry in your log, your observing skills will become more finely honed. ■

Tom Johnston is an avid comet and galaxy observer living in Boulder, Colorado. He builds telescopes for Jim's Mobile, Inc.

Bright P-K Planetaries

P-K	R.A. (2000.0)	Dec.	Mag.	Size	Type
47+42.1	16h27m30s	+27°54'2"	13.0	170"	Smooth disk, traces of ring structure
36–1.1	19h2m1s	+02°9'2"	13.2	>107"	Irregular disk, traces of ring structure
41–2.1	19h18m27s	+06°32'4"	11.5	>109"	Irregular disk, traces of ring structure
77+14.1	19h19m12s	+46°14'4"	13.5	190"	Smooth disk, uniform brightness
79+5.1	20h9m6s	+43°43'5"	13.7	20"	Smooth disk, ring structure
85+4.1	20h32m24s	+47°21'2"	14.0	157"	Irregular disk, traces of ring structure
59–18.1	20h51m6s	+13°33'1"	13.8	130"	Irregular disk, traces of ring structure
72–17.1	21h16m50s	+24°9'4"	12.2	831"	Smooth disk
81–14.1	21h35m36s	+31°41'1"	13.4	101"	Ring structure
103+0.1	22h16m6s	+57°29'0"	13.5	41"	Smooth, irregular disk

This table provides the designations for 10 Perek-Kohoutek planetary nebulae as well as positions in right ascension and declination, visual magnitudes, sizes in arcseconds, and types.

ADORAMA INC.

42 WEST 18th STREET • NEW YORK, NY 10011

PHONE ORDERS ACCEPTED DAY OR NIGHT
• Mon–Thurs. 9 till 9:30 PM
• Fri. 9-1:45
• Sunday 9:30–6 EST

STORE HOURS:
• Mon.–Thurs. 9–7pm
• Fri to 1:45
• SUN 9:30–5:45

ORDER TOLL FREE • US & CANADA
800-7-ADORAMA
8 0 0 - 7 2 3 - 6 7 2 6
ORDERS & INFO **212-647-9800**
FAX **212-929-9013**
CUSTOMER RELATIONS • 800-815-0702
• Mon–Thur. 9-4:30, Sun. 11-2 EST
E-mail: goadorama@aol.com

COMPLETE with MANUFACTURER'S ACCESSORIES

Meade®

4500 4.5 Equatorial Reflector	379.95
Infinity 114 4.5 Equatorial Reflector	189.95
Saturn 114 4.5 Equatorial Reflector	239.95
Saturn 60mm Altazimuth Refractor	94.95
Saturn 60mm Equatorial Refractor	139.95
227 60mm Altazimuth Refractor	119.95
230 60mm M/C Altazimuth Refractor	149.95

SOFTWARE

Astro Search 200	19.95
Epoch 2000 Sky Software	99.95
64,000 Object Library for LX200 (Version 3.1)	9.95

CLOSE OUT

ACCESSORIES

Carry Case f/LX50/200 10"	49.95
18V AC Adapter f/LX-200	24.95
Electric Focuser #1207	99.95
LX 200 3.4 Upgrade Kit	399.95
4" Photo Guide Bracket	39.95

Celestron

5" compact scope

C5+ 1250 F/10 Schmidt Cassegrain
DC with Hand Control

C5+Telescope w/DC Drive	Call
C5 Spotting Scope	Call
C5 Tripod	224.95
Glass Solar Filter for C5	64.95
Radial Guider C5,C8	109.95
DEC Motor C5	89.95
JMI Focus Motor C5	94.95
New! Carry Case with Wheels for C5/C5+	174.95
Piggyback Counterpoise C5	59.95
Advanced Astro Master f/C5	449.95

Celestron Reducer/Corrector f/6.3

This combination focal reducer and field corrector lens accessory works with all Current Celestron and Meade Schmidt Cassegrains. Now it is possible to have a dual focal ratio instrument without sacrificing image quality. The Reducer/ Corrector is f/6.3 for C8 and C11, f/7 for C14. A four element, fully multi-coated accessory. Results are amazing BOTH visually and photographically. **112⁵⁰**

Celestron/SBIG CCD CAMERA

Celestron/SBIG Pixel 225 CCD Camera	*1499.00*
Celestron/SBIG Color Wheel	*369.00*

Telescope Accessories

DEW SHIELD

Collapsible, fold down, easy to store and transport

for Celestron C90	**18.95**	for Meade 2045	**18.95**
f/8" Schmidt Cassegrains	**28.95**	f/10" Schmidt Cassegrains	**38.95**
f/5" Scopes	**24.95**	f/11" Scopes	**49.95**

LUMICON FILTERS

BUY ANY 2 FILTERS
AND TAKE 7% OFF THESE PRICES
UHC PREMIUM, DEEP SKY PREMIUM, H-BETA or OXYGEN III

1¼"	**99.50**	2" Rear Cell	**199.95**	48mm	**199.95**
2" T Mount	**199.95**	Deep Sky .96"	**76.50**		

THOUSAND OAKS (Mounted Glass) SOLAR FILTER

Stainless Steel Coated (type 2)

- **for Celestron C90's**
- **for Televue Genesis**
- **for Meade 2045**
- **for Televue** Pronto/Ranger
- **for Celestron C5's**
- for Schmidt Cassegrains 8"
- **for Meade 10"**
- **for Celestron C11**

Now Available at Greatly Reduced Prices

TYPE 2 PLUS

8"	**Call**	10"	**Call**

H-Alpha Solar prominence filter w/white light Pre Filter 8" **695.00**

NEW L PRO FILTERS

1.25" Broad Band	79.00	**2' Broad Band**	119.00
1.25" Narrow Band	89.00	**2' Narrow Band**	179.00
1.25" Oxygen/H-Beta	89.00	**2' Oxygen/H-Beta**	179.00

TELRAD FINDER

TELRAD with Base	**36.95**	Spare Mounting Base	**7.95**
Dew Shield for Telrad	**11.95**	Pulsar Unit	**19.95**

1.25" RACK & PINION FOCUSERS

New Celestron 1.25" Focuser **39.95**

NEW CELESTRON SECONDARY MIRRORS

1.14"	**19.95**	1.57"	**26.95**	2.75"	**39.95**

JMI FOCUSERS

NGF-1	**209.**	NGF-2	**159.**	NGF-3	**129.95**
NGF-4	**109.**	NGF-S with Motofocus	**239.95**		

1.25" NGF MINI FOCUSERS

NGF-1 Mini	**139.95**	NGF-2 Mini	**114.95**	NGF-S Mini	**184.95**

FOCUS MOTOR f/Meade LX200 ......**79.95**

Tele Vue®

PLOSSL		PANOPTIC		NAGLER	
55mm 2"	**Call**	15mm 1¼"	**Call**	20mm 2"	**Call**
40, 32mm 1¼"	**Call**	19mm 1¼"	**Call**	16mm 2"/1¼"	**Call**
10.5 Plossl	**Call**	27mm 1¼"	**Call**	12mm 2"/1¼"	**Call**
		22mm 1¼"	**Call**	13mm 2"/1¼"	**Call**
		35mm 2"	**Call**	9mm 2"/1¼"	**Call**
		Panoptic Barlow Interface 2"	**Call**	7mm 1¼"	**Call**
				4.8mm 1¼"	**Call**

NEW DESIGN PLOSSLS		BARLOW	
8mm 1¼"	**Call**	Short Tube 2x 1¼"	**Call**
11mm 1¼"	**Call**	3X 1¼"	**Call**
15mm 1¼"	**Call**	Big Barlow 2x 2"	**Call**
20mm 1¼"	**Call**		
25mm 1¼"	**Call**		

ACCESSORIES

Bino-View Binocular Viewer ......**Call**

STAR DIAGONAL	RICH FIELD KIT	PARACORR
2" Star Diagonal ......**Call**	with 55 Plossl 2" Diag., 2" to 1¼" Adapter **359.95**	2" COMA CORRECTOR **Call**
1.25" Star Diagonal ......**Call**		

TELE VUE REFRACTORS

RANGER 70mm ED Lightweight Scopes

RANGER Ivory w/1.25" 45° Erect Diagonal & 26mm Plossl	**Call**
RANGER Ivory w/1.25" Straight Erect Prism & 26mm Plossl	**Call**
RANGER Ivory w/1.25" Star Diagonal & 26mm Plossl	**Call**
RANGER BRASS w/1.25" Star Diagonal & 26mm Plossl	**Call**
PRONTO 70mm Aperture f/6.4 with ED Glass	**Call**

GENESIS

Genesis-SDF ....**Call** **Renaissance SDF .CALL**

Tele Vue Mounts & Accessories

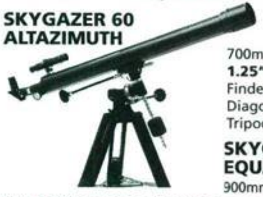
GIBRALTAR MOUNT Ashwood	**Call**
GIBRALTAR MOUNT Walnut Wood	**Call**
WALNUT PANORAMIC MOUNT with Brass Fittings	**Call**
STARBEAM ."Red Star" Projection Finder	**Call**
PIGGY-CAM Camera Adapter	**41.95**
QUICK POINT Day/Night Sighting	**29.95**

SKYGAZER SERIES TELESCOPES

90mm SKYGAZER EQUATORIAL Refractor Includes 3 high quaility 1.25" eyepieces (6.5, 10 and 25mm) Short tube Barlow, T-adapter, Adjustable tripod with tray, slow motion controls, 6x30 finder.**399.95**

80mm Equatorial 910mm focal length (f/11.4) German Equatorial Mount, slow motion controls, setting circles, 25mm 1.25" eyepiece (36X), 1.25" diagonal, 6x30 finderscope, adjustable wood tripod......... only **289.95**

SKYGAZER 60 ALTAZIMUTH



Features a quality 700mm f/11 Refractor, **Two 1.25" Eyepieces,** 5x24 Finderscope, Hybrid 1.25" Diagonal, Adjustable Wood Tripod .... only **114.95**

SKYGAZER 60 EQUATORIAL

900mm f/15 Refractor, **Two 1.25" Eyepieces,** German Equatorial Mount, Slow Motion Cables, Setting Circles in both axes, 6x24, Finderscope, Hybrid 1.25" Diagonal, Adjustable Hardwood Tripod .... only **149.95**

New ***Motor Drive*** for Skygazer114

89.95

SKYGAZER 114 (4.5) **Equatorial Deluxe Reflector**
259.95

114mm diameter Reflector with German Equatorial Mount, Slow Motion Controls in R.A. and DEC., 5x24 Viewfinder, Two 1.25" 25mm (36X) & 10mm (91X) Eyepieces, Adjustable Wood Tripod w/Accessory Tray

New EQUATORIAL MOUNT with Tripod and Slow Motion Controls (same mount as supplied w/Skygazer 114) **129.95**

New SKYGAZER 114 Heavy Duty Equatorial Refractor with two 1.25" eyepieces and Heavy Duty Polar Aligned equatorial mount..........................**399.95**

USED TELESCOPES

READY TO UPGRADE YOUR TELESCOPE?
CALL US FOR AN EVALUATION
LOOKING TO BUY A USED TELESCOPE?
We Deal in Second Hand Telescopes, Spotting Scopes & Acces.

CELESTRON®

SCHMIDT CASSEGRAIN

ULTIMA 2000	**2699.00**	**Celestar 8**	**Call**
Ultima 9¼ PEC	**Call**	**Celestar 8** computerized	**Call**
Ultima 11 PEC	**Call**	Hand Control f/Celestar	**64.95**
New Fastar 8	**2299.95**	**New Celestar 8 Deluxe**	**Call**
CG-9¼	**Call**	**GP-C8**	**1299.00**
CG-11 ...**Call** **CG-14**	**Call**	**8" S.C.** Tube only	**699.95**

REFLECTOR TELESCOPES

C4.5" Newtonian Multi-Coated	**Call**
Motor Drive f/C4.5	**274.95**
Firstscope 114 Deluxe	**Call**
Firstcope 76 3" Reflector	**Call**

Star Hopper Dobsonian

4.5" Star Hopper	**199.95**
6" Star Hopper...**Call** 8" Star Hopper	**Call**
New 8" Star Hopper w/Aluminum Tube	**Call**
6x30 LER Finderscope f/Dobsonian	**41.95**
Digital Setting Circles f/Dobsonian	**549.95**

REFRACTOR TELESCOPES

G.P. C102 ...**1299.95** G.P. C102 ED	**Call**
Firstscope 80 Equatorial	**299.95**
Firstcope 80 W.A. Equatorial	**Call**
Firstscope 60 Deluxe	**119.95**
Firstscope 60 Equatorial	**159.95**

SPOTTING SCOPES

C90 Multi Coated w/1.25" Eyepiece

Celestron 1000mm f/11 Multi-Coated f/11 Optical Tube, 1.25" 45° Erect & 25mm 1.25" Eyepiece with Case................ **Call**

Other Models in Stock

Rich Field 80	**Call**		
New **Ultima 80**	**Call**	500 f/5.6 Spotting Scope	**Call**
15-60X Zoom	**179.95**	f/4 Adapter for 500/5.6	**74.95**

CELESTRON C90 & SPOTTING SCOPE ACCS.

Barlow .96, 2x M/C Short Tube	**44.95**	Polarizer Set .96	**19.95**
6.3, 7.5, 10, 17, 26 Plossl .96	**44.95**	Star Diagonal .96	**19.95**
Moon Filter .96"	**9.95**	1.25" Diag Prism 45° .for C90	**34.95**

CELESTRON TELESCOPE ACCS.

AC Adpt. C5+, C8+ Ultima	**19.95**
Car Bat. Adpt. C5+,C8+ Ultima	**24.95**
2X **Barlow** 1.25" **Short Tube**	**44.95**
Counterweight Bar Assembly 8" ....**89.95** or 11"	**94.95**
Case for C8	**174.95**
New! Dew Eliminator	**17.95**
Piggyback Mt 8"	**34.95**
Piggyback Bar Assembly 11"	**69.95**
Dewstar/Shade 8"	**26.95**
JMI DEC Motor C8+/Classic 8	**74.95**
JMI Focus Motor C8+/Classic 8	**89.95**
Celestron Focus Motor	**109.95**
Dual Axis Drive SP/GP	**319.95**
ADVANCED ASTRO MASTER	
Advanced Astro Master for C8, Ultima-9-11	**524.95**
for GP/G-9/GII	**569.95**
FILTERS	
LPR A ......**59.95** LPR B	**84.95**
Pol. Set 1¼"**44.95** Sky Filter #2	**46.95**
4 piece 1.25" FilterSet	**49.95**
New Comet FilterSet	**34.95**
Glass Solar Filter 8"	**74.95**
DIAGONALS	
Diagonal Erect 1.25" 45°	**41.95**
Diagonal Erect 1.25" 90°	**49.95**
2" Mirror Star Diagonal	**134.95**
Star Diagonal 90 Degree	**39.95**
FINDERSCOPES	
9x50 Finderscope Kit	**89.95**
6x30 Finderscope Kit	**46.95**
7x50 Polaris Finder Scope with Illuminator & Bracket	**169.95**
Quick Release f/7x50 find	**44.95**
Star Pointer Finderscope	**37.95**

GUIDING SYSTEM	
Radial Guider	**109.95**
Micro Guide Eyepiece	**157.95**
7.5 Plossl Illum. Reticle	**164.95**
20mm Cross Hair Eyepce.	**38.95**
Pulsar Illuminator	**56.95**
TRIPODS & MOUNTS	
Adj. Tripod Heavy Duty	**264.95**
Lightweight Tripod	**224.95**
Alt-Azimuth Mount	**189.95**
Photo Tripod	**99.95**
Great Polaris 8" Mount. with Polaris Finder	**649.95**
Vibration Suppression Pads	**39.95**
G-SERIES MOUNTS	
G 9 Mount	**1449.95**
G 11 Mount	**1849.95**
NIGHT VISION ASTROLIGHTS	
Disposable Astrolite	**3.95**
New Night Vision LED Light	**21.95**
T-ADAPTER/TELE EXTENDERS	
Tele Extender Deluxe	**48.95**
T-Adapt. f/Schmidt Cassegrains	**24.95**
T-Adapter Refractor/C4.5	**34.95**
T-Adapter/Barlow Lens 1.25"	**49.95**
T-C 16mm Adapter	**29.95**

New! Focus Micrometer **114.95**

CELESTRON ZOOM 1¼" EYEPIECES

Deluxe zoom Ocular 6.5-18mm Ortho **146.95**

ULTIMA EYEPIECES

5mm, 1¼"	**76.95**	7.5, 1¼"	**74.95**	12.5mm, 1¼"	**74.95**
24mm, 1¼"	**79.95**	30mm, 1¼"	**86.95**	18mm 1¼"	**84.95**
42m, 1¼"	**109.95**	35m 1¼"	**104.95**		

Ultima 2X Barlow Short Tube Version ....**Call**

PLOSSL EYEPIECES

6.3, 7.5, 12.5, 10, 17, 20, 26mm, 1¼" ......**43.95** 32, 40mm, 1¼" **59.95**

Vixen Lanthanum Eyepieces LV Series

2.5mm,	**129.95**	4mm	**119.95**	5mm	**114.95**
6mm,	**112.95**	9mm	**114.95**	10mm	**109.95**
New 12mm	**114.95**	15mm	**114.95**	30mm 2"	**159.95**

New 8-24mm Zoom **174.95**

New Pentax XL SMC Eyepiecrs

5.2, 7, 10.5, 14, 21, 28mm, 1.25" ....**Call** 40mm, 2".....**289.95**

WE SHIP PROMPTLY. ALL TELESCOPES INCLUDE U.S.A. WARRANTY

No Surcharge for MasterCharge or Visa Purchases. Personal checks welcome, will ship without delay. Name must be imprinted on check, also include address, phone, and a copy of major credit card or driver's license for reference. Shipping, handling and insurance additional. 14 day money back guarantee less shipping, with packing and blank warranty card, except film and paper. We ship UPS. Some items special order. All orders are subject to acceptance and verification. Second hand dealer's license #802862. Pictures are for illustration purposes only and may not be exact. Wa are not authorized Meade dealers.

Prices effective till June 20, 1997 **Please address all inquiries and orders to ASTRO. DEPT. #55**

ADORAMA

42 West 18th Street • New York, NY 10011 6

ORDER TOLL FREE **800-723-6726**

ORDERS & INFO **212-647-9800**

FAX # 212-929-9013

ASTRONOMY BOOKS

Books for Beginners

Beginners Observing Guide	11.95
Nightwatch: Equinox Guide	22.95
Astronomy: Self-Teach Guide	17.95
Guide to Amateur Astronomy	34.95

Binocular Observing

Binocular Astronomy	24.95
Touring the Universe Through Binoculars	28.95
Deep Sky Objects	8.95
Exploring the Night Sky	7.95
Exploring the Moon	14.95

Star Atlases

Sky Atlas 2000 Deluxe.	41.95
Sky Atlas 2000 Field Ed.	21.95
Laminated Sky Atlas 2000 Field Edition	59.95
Sky Atlas 2000 Comp.	24.95
Sky Catalogue 2000. Vol. 1 or 2 2nd Ed. (paperback)	39.95
Bright Star Atlas 2000	10.95
Celestron Sky Map	16.95
Atlas of Deep Sky Splendors 4th Edition	24.95
Uranometria 2000	39.95
Deep-Sky Field Guide to Uranometria 2000	49.95

GLOBES

S&T Mars Globe 12" scale model w/100+ geographic features, clear pedestal & booklet 84.95

S&T Venus Globe 12" color coded scale model also includes 3-D booklet......94.95

URANOMETRIA 2000.0

Observers' Handbooks

The Backyard Astronomer's Guide	29.95
1000+: The Amateur Astronomer's Field Guide to Deep-Sky Observing	34.95
The Sky: A Users Guide	14.95
Star Hopping by Macroset	19.95
City Astronomy	18.95
The Messier Album	21.95
Burnham's Celestial Handbook 3 Volume Set	39.95
Observing Handbook & Catalog of Deep Sky	49.95

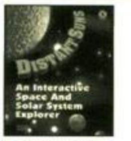
Astrophotography & Imaging

Astrophotography: Intro	18.95
Astrophotography II	18.95
Astrophotography for the Amateur	19.95
Choosing & Using a CCD Camera w/ 3.5" Disk	29.95
Introduction to Astro. Image Processing	29.95
CCD Astronomy	24.95
CCD Camera Cook Book	29.95

Building Telescopes

How To Make A Telescope	19.95
Build Your Own Telescope	24.95
Starware	24.95
Telescope Building w/Dobson Video Tape	39.95

ASTRONOMY SOFTWARE



Distant Suns CD

Lets you manipulate the planets & land on Mars......**28.95**

New! The Mars Rover CD Rom	28.50
The Mars Explorer –	28.95
The Venus Explorer –	28.95

Red Shift 2 (CD) **39.95**

THE SKY
for Windows 95

Sky Level 2	Call
Sky Level 3	Call
Sky GSC (CD ROM) Level 4	Call
LX-200 Interface	24.95

ADDITIONAL SOFTWARE

Skygazer CD (MAC)	44.95
Sky Catalog Vol 1 or 2 (CD /DOS)	29.95
Deep Space (CD /DOS)	129.95
Deep Sky Planner (DOS)	34.95
Astroware 1 CD ROM	38.95
PC Sky (DOS)	98.95
Starry Night Deluxe	97.95

DANCE OF THE PLANETS

Dance of the Planets Standard Edition	74.00
Star 8 Extension.	29.95
Star 10 Extension	49.95

NIGHT VISION

BINOCULARS

30,000X 2.5X Magnification	419.95	**MPN-40K 30,000X** 4X Mag.	479.95
30,000X Goggles 1X Mag. Focuses as close as 9"	649.95		

MONOCULARS

Moonlight Mini 2000X Very Compact	219.95
NV-100Z **10,000X** Mono w/Illuminator	299.95
NV-100CI **5000X** Compact w/Illum. 2.4X	289.95
MPN-60K **60,000X** Gen III	1149.95

NEW TASCO

NV-245 **Gen 2 Bivision**	1199.95
NV-365 **Binocular**	579.95
NV-360 **Monocular**	349.95
Camera Adapter for 360	49.95

Pro-Optic NV-2000

Compact High Performance Night Vision SCOPE *with Illuminator*

Features include a special tube protection device to eliminate overexposure, and infrared illuminator used in total darkness. Can be hand held or mounted on a standard tripod. Uses 2 standard AA batteries, **with Pouch Case**

149.95

BINOCULARS

Pro-Optic

Now includes 25 YEAR WARRANTY

These binoculars with their large objectives high quality BAK-4 prisms will provide you with breathtaking wide-field observation of astronomical objects as well as terrestrial viewing under low light conditions.

Each binocular is provided with a high quality Hard Case, Neck Straps and Rubber Eye-Cups.

***10% OFF* Introductory Special**
10% off the price of the 70mm Jumbo Binoculars (exp. June 30, 1997)

New 70mm Jumbo Fully Multi-Coated Series

11x70 Jumbo – 4º field of view, 21mm eye relief, weighs 2.8 lbs.	199.95
16x70 Jumbo– 3.6º field of view, weighs 2.8 lbs.	209.95

80mm Giant Fully Multi-Coated Series

11x80 Giant –	284.95
20x80 Giant –	289.95

100mm Ultra Giant Series

The ultra large aperture of 100mm provides more than 50% more light gathering power than the standard 80mm Giant Binoculars. For a delightful experience in astronomical viewing.

Both feature multi-coated optics, BAK-4 prism, built-in platform which mounts on a tripod.

14x100 Ultra Giant	999.95	**25x100** Ultra Giant	999.95

FUJINON FMT-SX Binoculars

6x30 FMTR-SX w/Rubber Coatings & fashion strap	Call
7x50 FMT-SX with Carry Case & fashion strap	Call
7x50 FMTR-SX w/Rubber Coating & fashion strap	Call
7x50 FMTR-CSX R.C.with Compass & fashion strap	Call
8x30 FMTR-SX Rubber Coated & fashion strap	Call
10x70 FMT-SX with Carry Case & fashion strap	Call
16x70 FMT-SX with Carry Case & fashion strap	Call
8x40 BFL w/Case	204.95
Tripod Adapter Large	19.95

10x70

GIANT BINOCULARS

25x150 ED EM	Call
25x150 EM	Call
40x150 ED MT	Call

Fieldscope Super 80

Super 80 with 20X-60X	574.95
Super 80 ED with 20X-60X	1039.95

CELESTRON

NEW GIANT MULTI-COATED

20x80 Basic	Call	20x80 Dlx	Call

NEW REGAL

8x42	Call	10x50	Call

ULTIMA SERIES

7x50	Call	8x40	Call
10x50	Call	10x42w.a.	Call
New 9x63	Call	8x56	Call

New PRO SERIES w/Focus Lock

7x50	Call	8x40	Call
10x50	Call	8-24x50	Call

ED GLASS SERIES

6.5x44	Call	9.5x44	Call

MINI M/C with Case

8x21	49.95	9x25	59.95
10x25	51.95	7-16x25 Zm	75.00
MONOCULAR– 8x25	39.95		

BUSHNELL

Discoverer 15-60 X60	179.95
Camera Mount f/Discoverer	14.95
Spacemaster	149.95
Spacemaster Rubberized	163.95
Spacemaster Kit w/15-45X, Tripod and Case	247.95
Elite 60mm w/15-45X Zoom	Call
Elite 77mm	269.95
Eyepieces & Accessories	Call

CANON

12x36 Image Stabilized	Call

PENTAX PCF

7x50	120.00	8x40	120.00
10x50	135.00	12x50	137.00
16x50	144.00	20x50	160.00

NIKON

SPOTTING SCOPES

15-45x60 Spotter R/C	339.95
15-45x Angle	354.95
16-47 X60 XL Waterproof SS	379.95
Photo Adapter f/SS	19.95

FIELDSCOPES (Body only)

Field Scope	319.95		
Field Scope Angle ED	639.95		
Field Scope ED 78mm Angle	1034.95		
15, 20, 30, 40X E.P.	@ 74.95		
24X WA	144.95	30X WA	139.95
60X	79.95		

ZEISS w/USA Warranty

20x60 Stabilized Monocular	Call
15x60 GA	Call
30x60 Spotting Scope	Call

LEICA w/USA Passport Warranty

10x50 BA	Call	8x50 BA	Call
7x42 GEOVID BDA	Call		
7x42 GEOVID BD	Call		

Leica Spotting Scopes

Televid 77mm Straight or Angle	Call
Televid 77mm ED Straight or Angle	Call

BINOCULAR ACCS.

Car Window Mount	34.95
Tripod Adapter	16.95

KOWA

Limited Availability

77mm SPOTTING SCOPES w/20-60x Zoom

TSN-2	534.95		
TSN-3	999.95	TSN-4	974.00

NEW 82mm SCOPES W/O EYEPIEC

TSN-821	459.95	TSN-822	419.95
TSN-823	989.95	TSN-824	934.95

Pro-Optic
Astronomical Accessories

A unique combination of high quality and economical prices

Pro-Optic Plössl 1.25" Eyepieces

• Sharp detail • High contrast ghost-free images • Wide 50° apparent field of view (43° on the 40mm Plössl) • 4 element optics, fully magnesium fluorite anti-reflection coating on each air to glass surface.• Lens edges are blackened to keep out reflected light • Accepts 1.25" filters.

New! 20mm Plössl 1.25"

40mm (Field of View 43°)	54.95		
32mm Plössl 1.25"	54.95		
25mm Plössl 1.25"	39.95		
20mm Plössl 1.25"	39.95	17mm Plössl 1.25"	39.95
12.5mm Plössl 1.25"	49.95	10mm Plössl 1.25"	39.95
7.5mm Plössl 1.25"	39.95	6.3mm Plössl 1.25"	49.95

BUY ONE EYEPIECE AND GET THE SECOND ONE *(of equal value)* ***AT HALF PRICE!***

New! Short Tube Barlow

Double the power of any eyepiece with this Barlow. Only 2¼" long. Works with all type of telescopes, including Refractors and Reflectors only **$39.95**

Pro Optic 500mm f/5.6 Maksutov Telephoto/Spotting Scope

With high-tech white finish

Carry Case
Pro-Optic
Nikon

Multi-coated to maximize contrast and sharpness and a built-in field flattener to reduce field curvature.
With its 500mm focal length, it is long enough for close-ups of far away objects but with the f/5.6 optics it is fast enough to be hand held, focuses as close as 5 feet.
With the addition of the SS500 Kit you can convert it to a 20X 90mm spotting scope. The SS500 kit includes a 45° 1.25" Erect Image Diagonal and a 25mm 1.25" Plossl

Pro-Optic 500mm f/5.6 lens	209.95
Pro-Optic SS500 Kit (when purchased w/500/5.6)	49.95
350mm f/4 Converter for 500/5.6	74.95
Celestron 1000mm f11 Multi-Coated Lens	only 299.95

Pro-Optic Slow Motion Control 29.95

With the Slow Motion control attached between your Lens/Spotting Scope and your photographic tripod, you can make accurate slow motion adjustments in altitude and Azimuth. In addition the Pro-Optic SMC allows you to make major adjustments in elevation with a separate control knob.
The Slow Motion Control fits any tripod with 1/4-20 thread.

Pro-Optic 45º Erect Image Diagonal

Provides an ideal 45° angle for erect image terrestrial viewing

Pro-Optic 45° Erect 1.25"	38.95
Pro-Optic 45° Erect Hybrid (1.25" to .96")	39.95
Pro-Optic 90° Star Diagonal 1.25"	34.95

EYEPIECE FILTERS 1.25"

Avail. in the following colors: 1A Skylight; 8 Yellow ;11 Yellow Green; 12 Deep Yellow; 15 Deep Yellow; 21 Orange; 23A Red; 25 Red; 47 Violet; 56 Light Green; 58 Green; 80A Light Blue; 82A Pale Blue; ND 0.3; ND 0.6

1.25"	Ea. 9.95
Moon Filter 1.25" (ND 9X)	11.95
Buy any 4 filters (1.25")	for only 34.95
Buy any 12 filters	for only 99.95

Special: *4 Piece Filter Set*
includes: #12, 23A, 58 & 80A
Packaged in a Pouch with space for additional filters **34.95**

Same as above with #11, 25A, 47 & 82A **34.95**

SEE OPPOSITE PAGE FOR ORDERING INSTRUCTIONS

STARGAZING AT KITT PEAK

Tom Polakis

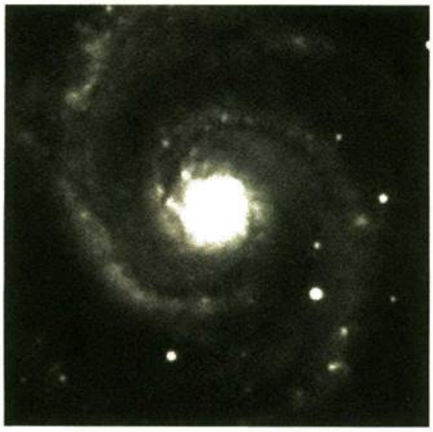
Across the country, observatories are experiencing funding cuts. Kitt Peak is resolving the challenge and inspiring the public at the same time.

By Tom Polakis

If your idea of a dream vacation is scuba diving in the Great Barrier Reef, you simply call a travel agent who will find you dozens of services that will train you to use the equipment, drop you off at the best dive location, and provide food and lodging. In fact, it's not difficult to find the same level of service involving premiere sites for almost any other outdoor activity, be it golfing, skiing, or taking a safari. Until now, amateur astronomers could only dream of having it so good. Five years ago, I endured a trip that, among other hardships, involved lugging a 100-pound telescope through airports en route to remote regions of Chile. Several times I wished in vain to have the equipment awaiting my arrival at the final destination. Well, with the recent renovation of the visitor program at Kitt Peak National Observatory, stargazers need lug no more.

Since October 1996, Kitt Peak has welcomed as many as 20 people per night to spend several hours on the mountain learning about the observatory's research programs, taking an "immersion course" in astronomy, and most importantly, gazing at the southwestern sky. *Astronomy* didn't have to ask twice for me to give the Kitt Peak Nightly Observing Program a go.

Located on the Tohono O'Odham Reservation, the mountain is a short



Adam Block

Kitt Peak's public observing program allows astronomers to take shots such as this CCD exposure of the Whirlpool Galaxy, made with a 16-inch scope.

drive from Tucson, Arizona. Its majestic form rises steeply from the Sonoran Desert into skies known to be clear and dark. The drive up the mountain to the observatory is an adventure in itself; the road transforms rapidly from straight and flat to near vertical with hairpin twists. Each turn bestows on those daring enough to make the trip a more spectacular view of the valley below than the turn before.

When I gained the 6,875-foot summit at the Visitors Center, I was mesmerized; I found myself surrounded suddenly by the observatories that had teased me during my approach. For a moment, it seemed as though the domed mosques of Istanbul were here, nestled in the Quinlan Mountains.

I could see the WIYN telescope dome in the distance, and the 2.1-meter and two others beyond it. The 4-meter observatory, a 94-inch half-dome and the 0.9-meter Space Watch dome stood behind me. The sharply-angled structure that houses the Solar Observatory filled my next view. I was in an astronomer's paradise and hadn't even left my car.

Daytime visitors to Kitt Peak clear out at 4 p.m. Only those with reservations for the Nightly Observing Program may stay on the mountain with the astronomers and technicians.

Each participant is handed a pair of 7x50mm binoculars, a planisphere, and a red flashlight for use during the session. The group convenes for dinner and to watch an introductory video, "Astronomy 101." Then everyone embarks on a magnificent journey through the universe by public program director Adam Block. Using a 16-inch Schmidt-Cassegrain telescope, Block shows the group examples of a planet, a multiple star system, a planetary nebula and open and globular clusters. He closes with a mind-boggling view of a distant galaxy.

The program begins 30 minutes before sunset and lasts for three hours. Though not widely publicized, it is typically fully booked many weeks in advance.

For the amateur astronomer in pursuit of the perfect dream vacation, Kitt Peak offers an advanced program. One or two amateurs are treated to an entire night on the mountain, beginning three hours after sunset — just after the conclusion of the Nightly Observing Program. An SBIG ST-7 CCD camera and a full set of eyepieces complement the equatorially mounted scope on a rock-solid pier. Visitors can send images they captured in the night to their homes electronically or save them on a 100 MB Zip cartridge. With the telescope's computer interface to TheSky software, locating objects requires no more than knowing an identification number and watching the scope slew. The entire assembly is enclosed in an 18-foot Ash dome, providing the protection needed from winds commonly present. One brisk February evening, I was the privileged pilot observer for this program.

Having become a connoisseur of Arizona's observing sites over the years, I was most interested in checking the quality of a site as important as Kitt Peak. With Tucson's 700,000 people just 60 miles away, I was pleasantly surprised to find a relatively small light dome to the east, affecting no more than 10 percent of the sky. A much smaller glow from Phoenix can be seen a hundred miles to the north, but one needn't worry about either of these population hubs interfering with observing. Sit back and wait for objects to rise away from the cities and into the dark sky. The only remaining lights of any significance come from the small community of Sells, 15 miles away and nearly a mile below. What's more, lighting ordinances in Arizona ensure that Kitt Peak will remain a dark sight for years to come.

It had been cloudy since early afternoon, but a clearing line rested enticingly over the western horizon well into the night. Satellite image downloads suggested that clear sky would move our way, but when? As any good amateur

The author stands next to Kitt Peak's 16-inch scope used for public observing programs.

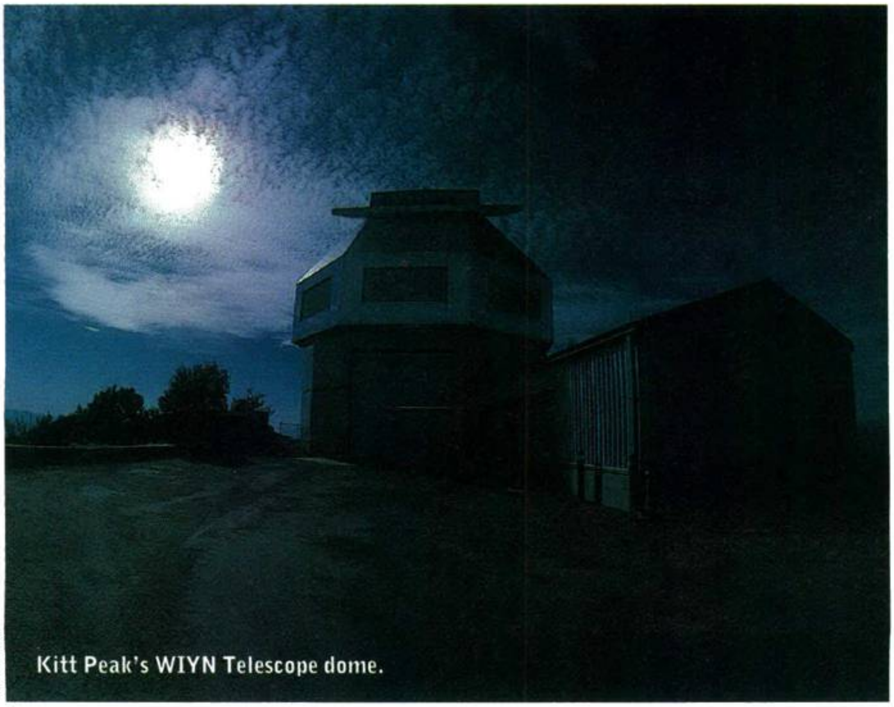
Tom Polakis

astronomer would, I took advantage of the clouds and sat down to discuss the current state of the hobby with Kris Koenig, the visitor center's administrator. The driving force behind Kitt Peak's latest changes, Koenig is passionate about promoting "astro-tourism."

Many national observatories face debilitating funding cuts. Koenig hopes the newly-developed programs will excite people about astronomy and help them see it as important and valuable. Kitt Peak National Observatory director Richard Green has similar expectations. He considers the new public program "a great way to reach our community and let them understand what is going on at the observatory." Peaking my excitement about astronomy was no challenge, and by 11 p.m. the clouds began to move away.

The sparkle of winter Milky Way stars in Monoceros and Puppis blazed well down into an inky southern horizon, where Canopus, the often neglected second brightest star, culminated. Temperatures in the 30s felt a little cold to this desert dweller, but they really weren't bad for a February night. To the northwest, the 18-story dome of the giant Mayall 4-meter telescope could be seen silhouetted against the setting constellation Cassiopeia. In the opposite direction, the sail of Corvus rose over the graceful structure of the McMath-Pierce Solar Telescope.

I'd recently ordered my own CCD camera. Eagerly awaiting its arrival, I wanted to try my hand at some imaging. I was amazed by how easy it was to acquire an image. I imaged the star cluster M46 with its planetary nebula NGC 2438 using a feature that allows observers to accumulate several short exposures. I moved to the Orion Nebula and then to the Horsehead Nebula, taking sets of 10-second exposures and performing simple image processes on each object. Excited and in an astrophotographer's mindset, I was amazed to learn how the four Trapezium stars could be extracted from the deep image that revealed outer filaments in the Orion Nebula. The experience made me all the more anxious to get my own CCD camera. Adam Block was helpful to have nearby — ready to assist, but never in the way.



Kitt Peak's WIYN Telescope dome.

Tom Polakis

My body cried for a rest at about 2:30 a.m., so I retired for a short nap before comet-rise. I was back at it at 5:30 a.m. as Comet Hale-Bopp gained a respectable elevation in the eastern sky. Using a pair of binoculars, I estimated the length of the ion tail at 7 degrees. The comet remained a captivating naked-eye sight in the rising twilight.

Uncomfortably cold and sleep-deprived at this point, I still couldn't resist staying up for the sunrise. These are the most peaceful hours at the observatory, just as the astronomers are

NIGHTLY OBSERVING PROGRAM RATES:

Adult $35

Child (under 18): $25

Family of four: $100

The three-hour program begins ½ an hour before sunset. A box dinner is provided which includes a meat or vegetarian sandwich, salad, drink, and dessert.

The program is limited to 20 participants each night.

Attendance is by reservation only: (502) 318-8726

ADVANCED PROGRAM RATE:

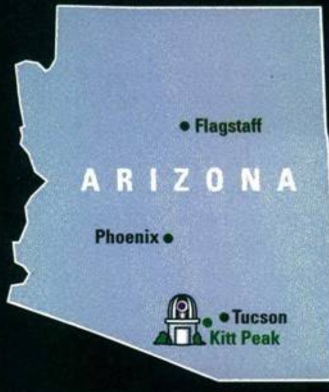
$250 plus $55 double occupancy room per night.

The program begins three hours after sunset and enrollment is limited to two participants each night.

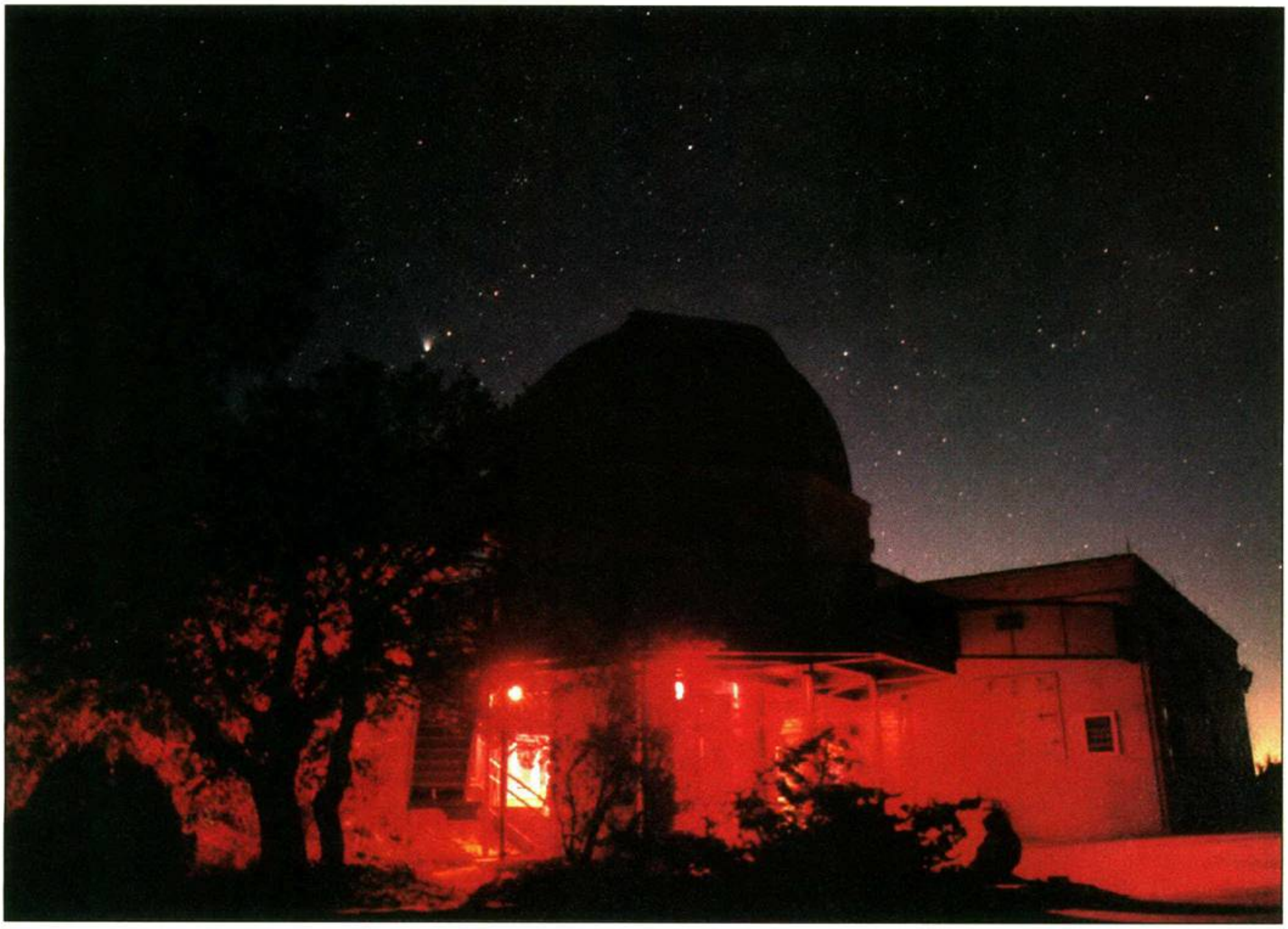
Attendance is by reservation only. Call (502) 318-8726.

Website:

http://www.noao.edu/noao/pio/pop/pop.html.



Astronomy: Elisabeth Rowan



Tom Polakis

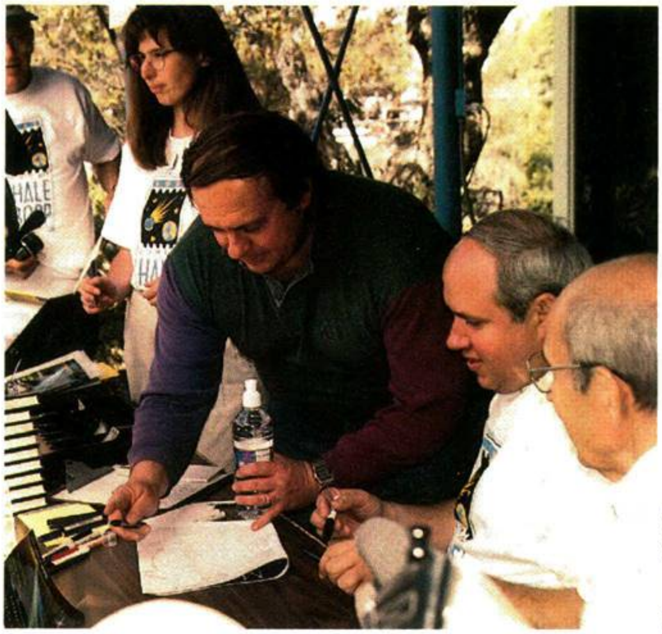
The 16-inch telescope dome stands on stilts in front of Kitt Peak's Visitors Center. In this image taken last winter, Hale-Bopp glows above the treeline.

going to sleep. Surrounded by the beautiful sight of domes basking in the colors of twilight, I was energized by the spectacle of the setting shadow of the peak projected on the atmosphere. The domes closed around me, and only early-rising birds broke the silence.

It was a few days before it all sank in. I had actually observed on Kitt Peak! I'd sat down to dinner with professional astronomers who chattered excitedly around me about their research. I'd been catered to while looking through a permanent scope at the Summer Milky Way at the largest observatory in the country on a February morning. It was the stuff of dreams.

Kitt Peak's visitor program indeed helped me realize a childhood dream and provided an amazing experience I will never forget. **A**

Tom Polakis is a deep-sky observer and photographer living under the dark skies of Tempe, Arizona.



Astronomy: Patti Kurtz

In late March 1997 visitors to Kitt Peak had the opportunity to meet comet discoverers Alan Hale (center) and Thomas Bopp (to Hale's left). Their comet made headlines during March and April.

Expand Your Universe

The Astronomical Society of the Pacific
and ASTRONOMY Magazine
proudly present:

UNIVERSE '97

June 28 & 29, 1997 Saturday and Sunday
Chicago – Hyatt Regency

Special Guest Speakers*:

- **Ray Arvidson**, Washington Univ., "Mars"
- **John Brandt**, Univ. of Colorado, "Comet Hale-Bopp"
- **Helene Dickel**, Univ. of Illinois, "Molecules in Space"
- **Alex Filippenko**, Univ. of California-Berkeley "Supernovae"
- **Jim Kaler**, Univ. of Illinois, "Stellar Evolution"
- **Rocky Kolb**, Fermilab, "Cosmology"
- **Mario Mateo**, Univ. of Michigan, "Dwarf Galaxies"
- **David Morrison**, NASA Ames, "The Threat of Asteroid Impacts"
- **Robert Morse**, Univ. of Wisconsin, "Neutrino Astronomy"
- **Leif Robinson**, Sky & Telescope, "Amateur Research Prospects"
- **Scott Sandford**, NASA Ames, "Meteorites from Mars"
- **Virginia Trimble**, Univ. of Maryland and Univ. of California-Irvine, "Technology & Astronomy Links"
- **Ray Villard**, Space Telescope Science Institute/Baltimore, "HST Results"

And also featuring:

- **Laura Danly**, Space Telescope Science Institute/Pomona, "Galactic Ecology"
- **Andy Fraknoi**, Foothill College, "A Skeptic's Guide to Astrology"
- **Richard Kron**, Univ. of Chicago/Yerkes Obs., "The Sloan Digital Sky Survey"
- **Seth Shostak**, SETI Institute, "The Search for Extra-Terrestrial Intelligence"
- **David Slavsky**, Loyola Univ., "The Physics of Baseball"
- **Panel discussion, "Science and Religion in the Golden Age of Astronomy" with George Musser of the A.S.P., Hector Avalos of the Committee for the Scientific Examination of Religion, Kitty Ferguson – Steven Hawking biographer, and Zachary Hayes of the Catholic Theological Union**

***All speakers and topics are subject to change**

PLUS:

A special presentation by NASA Astronaut Steven Hawley and Doug Duncan of the A.A.S. and Adle Planetarium on the Hubble Space Telescope, Friday evening June 27.

Book signings with Don Osterbrock, former director of Lick Observatory, "The Birth, Near Death, and Rebirth of Yerkes Observatory," Rocky Kolb, Fermilab, "Blind Watchers of the Sky," William Sheehan, "The Immortal Fire Within" and "The Planet Mars" and Gale Christianson, Indiana State Univ., "Edwin Hubble: Mariner of the Nebulae."

Family Fair—hands on astronomy demonstrations for kids by children's author Necia Apfel, Karen Randall of the Chicago Academy of Sciences, and Sheldon Schafer from the Lakeview Museum & Planetarium.

Over 40 exhibitor's displays including telescopes and accessories, software, books, and other educational materials.

Pre-registration advised

Contact:
Annual Meeting A.S.P.
390 Ashton Avenue
San Francisco, CA 94112
Phone (415) 337-1100
Fax (415) 337-5205
e-mail lkeechler@aspsky.org
www.aspsky.org

a part of the
109th
annual meeting of the
astronomical
society of the pacific

0207-9703AAod

At Roger W. Tuthill, Inc.,
We Don't Just RESHIP Meade and Celestron Scopes as Others Do,
We Test Them Individually.

Our Experience of 25 Years Lets Us Apply a "Personal Touch", Inspecting & Improving the Telescopes We Sell. Our Line of Accessories Makes Them Easier to Use and Gives You Less Hassle. Why Gamble With a Big Volume, Impersonal, Quick-Sale-Mail-Order Company? For Answers or Advice, Call TOLL FREE 1-800-223-1063 and Talk to **Astronomers, NOT Clerks.**

WE NOW OFFER "TWO-TIER PRICING" – A NEW CONCEPT

Send a 9" x 12" S.A.S.E. with 4 stamps for complete catalog. Includes prices and description of **DELUXE CERTIFIED SCOPE PACKAGES** for Meade 7", 8", 10", LX10 , LX50 & LX200, as well as 12" LX200, and Celestron C5+, Celestar 8", Ultima 9¼", and Ultima 11".

All DELUXE CERTIFIED MEADE and CELESTRON S.C.T.s come with:

- **Tuthill Inspection, Guarantee and After-Purchase Support**
- **Free set of Tuthill Astro-video Instruction tapes.**
- **25% off Tuthill accessories when purchased with scope.**

Visit our showroom. We carry binoculars, Lumicon filters, JMI products, Tele Vue refractors, astronomy books, software, and ALL brands of accessories.

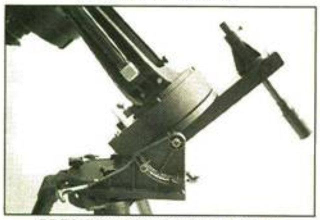
We clean and repair Meade & Celestron SCT's.

Tuthill Accessories

Meade 8" LX50 or Celestron Ultima 9¼" on Isostatic Equatorial Mount

Heatable NO DU CAPS for SCTs and Refractors

80mm Erect Image ULTIMATE FINDER includes bracket and 21mm ocular.


PRECISION POLAR AXIS FINDER® for EXACT polar alignment in minutes.

Roger W. Tuthill, Inc.
11 Tanglewood Lane, Dept. A • Mountainside, NJ 07092 • Phone 908-232-1786 • FAX 908-232-3804
VISA, MC, COD, Personal Checks, Time Payment Plans

A new concept in lightweight, adjustable aluminum cells.

Made from 100% solid aluminum sand castings, the new open cell design lets your mirror reach thermal equilibrium faster. Mirror carrier is spring-loaded with locking screws. 6" or 8" fits tubes from 6.75" to 10". For **4-1/4" mirror— $24.95, 6"— $29.95, 8" — $34.95, 10" — $47.95, 12.5" — $49.95, 13.1" — $49.95**

Fully Adjustable 4-Vane Spiders

Tell us your exact tube O.D. **Minor axis size 1.3" – $27.95, 1.52" – $28.95, 1.83" – $29.95, 2.14" – $34.95**. Normal delivery time on spiders is about 5 days.

Telescope Tubing

These clean, new spiral-wrap fiber tubes have the exterior primed white. Much lighter than Sono-Tube. **8" I.D. x 48" – $34.95, 10" I.D. x 48" – $44.95, 12" I.D. x 60" – $59.95.** (UPS charges to your door will be added.)

Vega-1, a rack and pinion focuser for 1-1/4" eyepieces.

Basic construction is aluminum with a chrome plated brass draw tube and helical rack and pinion. 4 tension adjustment screws. Racked-in height is 3". Provision for single vane holder. All hardware included **$64.95**

The Vega-2 is the perfect match for those large Newtonians.

For years, the first choice of custom reflector builders, the Vega-2 offers a helical-cut rack and pinion, all metal construction, and large 1-1/2" focusing knobs. Takes 2" O.D. eyepieces and comes with a 1-1/4" adapter. Racked-in height is 3-3/4". All mounting hardware included–**$119.95**

The Vega-3 and Vega-5 are precision low-profile focusers.

These two new low-profile helical thread mounts stand only about 1-1/2" high. These are all aluminum construction and each unit has been hand fitted for an oil smooth thread fit. The 2" Vega-3 model is the perfect replacement unit for 1-1/4" devices found on some Dobsonian telescopes. The **2" Vega-3** is priced at **$59.95**. Add **$10.95** if you need a **1-1/4" adapter**. The smaller **1-1/4" Vega-5** is **$39.95**.

The Wide-Angle König-2 leads the field in premium quality oculars!

You told us that the König design just couldn't be improved upon, yet our new König-2 series of 1-1/4" oculars have improved multi-coating and darkened lens edges for breathtaking visual contrast. Special non-reflective black ocular caps. Protective caps on both ocular and barrel ends. The 32mm model uses large 2" lenses set in a 1-1/4" format.
6.5, 8, 12, 16, or 24mm .... Call
32mm, 2" O.D. . $124.95, 55mm Plössl, 2"O.D. . .$119.95

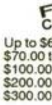
New FAX number – (313) 665-1815

University Optics – for 30 years your source of exceptional quality telescope components

New Excellent Quality 11x80 Finders
Right angle or erect image models. **Call for Prices!**

Classic Orthoscopic Eyepieces are still available!

Yes, we are still selling loads of these 4-element orthoscopic eyepieces that in terms of resolution, put some of the expensive occulars sold elsewhere to shame! If you are looking for *maximum resolution, keep the number of elements down to four!* Fully coated with standard filter threads. 1-1/4" O.D. **5, 7, 9, 12.5, 18, or 25mm . . . Call**



The Klee.™ Not just another Barlow!

Designed by the master opticians who brought you the Pretoria, the 2.8X Klee has earned a reputation among experienced observers as the ultimate in image amplifiers. Only 2-1/4" long due to its unique 3 element air-spaced design. Multi-coated .... **Call**

Large Deep-Sky Binoculars

These are the original high quality 80mm binoculars we have been selling for years updated with full multi-coating and BAK-4 prisms. Available in 11 or 20 power, they come complete with **case, tripod adapter, central support between the objectives, and collimation certificate.** Don't buy any large binoculars without talking to us first! **11 x 80 or 20 x 80 ...... $379.95 ea.**

Free Offer! Order one of our 11 or 20 power binoculars and get a copy of ***Choosing, Using & Repairing Binoculars*** as a bonus! (a $19.95 value)

FREE CATALOG

Postage and Handling

Merchandise Total with Shipping Charge

FREE CATALOG

Up to $69.99	$4.95
$70.00 to $99.99	$5.95
$100.00 to $199.99	$6.95
$200.00 to $299.99	$7.95
$300.00 and up	$8.95

Please Note–
Our postage and handling are based on the total value of the order, not per individual item. Just one more way we save you money!

HOW TO ORDER

Free Catalogue–If you would like our brochure, we will send it free via 3rd class mail. If you wish it 1st class, please send $1.00. **Catalogues outside the U.S.A. are $3.00.**

Mail Order–Simply write us a letter with your requirements. Payment via VISA, MASTERCARD, personal check, or money order.

Guarantee–It has been our policy for the last 30 years to always offer a money-back guarantee on all our items.

All prices and specifications in this ad are subject to change without prior notice. Our phone numbers are **313-665-3575** and **800-521-2828**. Hours are 9:30 a.m. to 5 p.m. EST, Monday thru Friday, 10 a.m. to 3 p.m. on Saturday.

TOLL FREE ORDER LINE – 800-521-2828
Catalog Requests, Questions –(313) 665-3575
University Optics
P.O. Box 1205 Ann Arbor, MI 48106

Our 8x50 Finders help you locate objects quickly and accurately!

Available in Brass

Our 8x50 finders come with a 1-1/4" wide-field eyepiece and diagonal. All-metal construction. Fully coated optics .... **Call**

8x50 Erect Image Model. We are now offering our high quality 8x50 finder with a right-angle Amici prism. Now you can read your star charts directly as you aim your telescope. No more confusing images! Once you try it, you'll never go back to reversed images .... **Call**

CCD Cookbook Camera Parts— build your own high-performance camera!

University Optics is offering a fully machined and superbly finished camera head aluminum parts set for ***The CCD Camera Cookbook***. Screwdriver assembly saves you hours and hours—makes building the camera a real joy. Please specify if building the 211- or 245-chip model. **Parts set $89.95**

Have your own lathe and milling machine? Even our unfinished aluminum components set can save you hours of precious time. Two special castings and all the right size aluminum stock needed for the camera head. **Phone, FAX, or write for latest parts list!**

The CCD Camera Cookbook by Berry, Kanton, and Munger. This is the book that **is destined to start the "do-it-yourself CCD revolution"!** Build a CCD camera that connects directly to your computer. Complete step-by-step instructions. Includes IBM-PC software to make it all happen. **Only .... $29.95 ppd.**

Electrical Parts for CCD Camera

We carry in stock the TC-245 and TC-211 chips as well as other electrical components needed to assemble the camera kit. Please call or write for current prices.

CHOOSING, USING & REPAIRING BINOCULARS
Choosing the Right Model
Using and Focusing Correctly
Collimation—Do it Yourself
Popular Myths About Optics Exposed
Perform Precision Repairs
Become an Informed Consumer
J.W. Seyfried

Choosing, Using, and Repairing Binoculars
by J. W. Seyfried

In this new book, every aspect of binocular design, usage, and repair is clearly explained. 55 illustrations and photos show you how to disassemble, optically align, and test your glass.

Build your own collimator! We show you how. Many folk never learned how to focus a binocular for optimum performance, Learn how! Never before published information on quality standards. What to look for when buying a binocular. Binocular myths exposed! ***Choosing,Using & Repairing Binoculars*** is an absolute wealth of information for the astronomer, naturalist, and sportsman. Softbound. 175 pages. **$19.95 ppd.**

Join the editors of ASTRONOMY for a luxurious

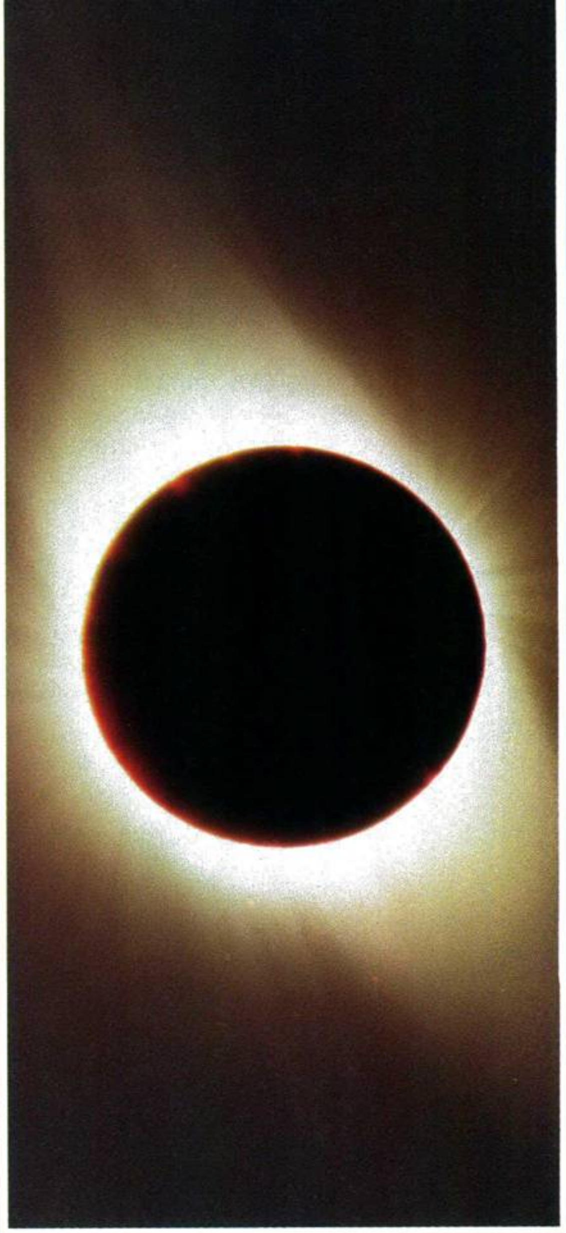
ECLIPSE CRUISE

Join ASTRONOMY editors on the luxury cruise liner Galaxy, the newest ship in Celebrity Cruise Lines' fleet, for the total solar eclipse in February 1998.

You'll enjoy a 7-day Southern Caribbean cruise from San Juan visiting exotic ports of call — Antigua, Barbados, Martinique and St. Thomas — during the day. And in the evening, observe the star-filled sky and southern constellations not visible from the U.S. Then, on February 26, join the editors to view the total solar eclipse through solar-safe filters.

A star-filled package for a great price

This is the only package that includes ASTRONOMY Magazine Editors Bonnie Gordon, Dave Eicher and Rich Talcott. They invite you to wonderful seminars and evening star gazing on the state-of-the-art observation deck. This program will please both beginners and expert astronomers alike. Trips start at only $1,275.00.



0222-9707AAad

Plus a FREE night's stay at a luxurious San Juan resort

This low price includes a night's stay on the beautiful island of San Juan where you'll be greeted by the ASTRONOMY editors. You'll enjoy an evening of relaxation and a get-acquainted event to mingle with other passengers. This is a trip you won't want to miss!

HURRY! We're filling up fast.
Call Specialty Tours today at:
1-800-677-9412

Astronomy

Eclipse photo taken by Ernest Piini.

★ ★ ★ BEST VALUES - LOWEST PRICES! ★ ★ TELRAD ★ PARKS ★ BUSHNELL ★ BRANDON ★ SCORPIUS ★ ASTRO SYSTEMS ★ SKY PUBLISHING ★ ★ ★

TELESCOPE TRADE-INS CONSIDERED ★ THOUSANDS OF ITEMS IN STOCK ★ TELEPHONE ORDER LINES 7 DAYS A WEEK ★ 9 AM TO MIDNIGHT ★ (860) 355-3132 ★ WE HAVE IT ALL ★

CELESTRON

IN THIS AD – LOOK
EYEPIECES FROM $12 EA/ FILTERS FROM $8 EA / TELESCOPES FROM $69

LOWEST PRICES

(860) 355-3132

LOWEST GUARANTEED LISTED PRICES

7x42 ULTIMA $179

CELESTRON

$AVE

TELESCOPES SCH/CASS.
C5 (AC) **C5+** (DC)
Computerized, GPC8, C8
Celestar 7 C8/11 2000

LATEST MODELS WITH PRICES TOO LOW TO PRINT

CG11, CG14, C14 Computerized	**Lowest Prices**

TELESCOPES REFLECTORS

C4.5, GP 200 7.9" FS 114 6" 8" DOB	from $249

TELESCOPES REFRACTORS

First Scope 80, 60, DX, GP 102, GP102 ED CO 40	$69

SPOTTING SCOPES - CALL

C90 all models, S50, C60RC, 20x60 WP, 20x60 Ed-WP, 30x60 RFT 80, S80, C5, C8, 500mm. f 5.6	from $189

BINOCULARS - PRICED TO SELL!

Monoculars 8x25.....$38, 6X16 ... $55	**UNBEATABLE**
Mini 8x25, 8x22, 10x25, 8x24PP, 10x24PP...$49	**PRICES**
Regal 10X50, 8X42	**ALL OTHERS CALL**
Pro 8x30, 7x50, 10x50, 12x50, 8x56, 9x63, 8-24x50 Zoom	
ULTIMA 8x32, 10x42, 7x50, 10x50, 8x56, 9X63	
ED SERIES 6.5x44, 9.5x44	ea $349
Water Proof 8x21, 11x80mm 20X80mm	

OPTICAL TUBE ASSEMBLIES - IN STOCK

80mm.........$279, 9 1/4"	$949
C8" Optical Tube Assem. Star Bgt. Case	$799
GP 102.......$724, C11.....$1595, C14	$3895

ULTIMA EYEPIECES

5mm, 18mm.......$74, 7.5mm.......$64, 12.5mm	$71
24mm.........$83, 30mm.........$92, 35mm, 42mm	$104
OR 6, 7, 9, 12mm (96")	ea $34
4, 6, 8, 12.5, 20, 25mm (.96) (MH)	ea $12
KE 10mm 16, 18 25 30 40 (96")	ea $33

PLOSSL OCULARS NEW CELESTRON SERIES

1 1/4" 6.3, 7.5, 10, 12.5, 17, 26mm $35 40mm, 32PL	$53
(.96) 7.5, 10, 12.5, 17, 26mm PL	$35
Zoom 6.5-18, 1 1/4" ORTHO.	$135
25mm K 1¼" Multi-Coated	ea $25
12, 25 Ortho (Multi-Coated) 1 1/4"	ea $49

REVOLUTIONARY LANTHANUM EYEPIECES -LV SERIES - STATE OF THE ART - RARE EARTH GLASS -

2.5 mm , 4mm, 20MM, 1¼"	$119
5mm, 6mm, 9mm, 10mm, 15mm.....$10⁹	
Coma Corrector Photo-Visual 1 1/4" - 2"	$99
Micro Guide Eyepiece	$156
Adapter 2" to 1 1/4".....$13, 1 1/4" to 2"	$29

T-RINGS - T-MOUNTS

(State Camera Make Model) All	$10 EA

CELESTRON

LOWER PRICE FOUND? JUST GIVE A CALL
9 AM TO MIDNIGHT - 7 DAYS

ACCESSORIES

AC Adapter (PEC) (C5+ C8+)	$18
Accessory Case -DELUXE-	$43
Barlow Lens 2x96" (Deluxe).....$46, 2X (.96)	$14
Barlow Lens 1 1/4" Short type (NEW)	$38
Barlow 2 x Ultima	$66
Barlow Lens 2x2" M/C (Giant)	$129
Binocular Tripod Adapter	$14
Car Batt. Adapter Ultima (PEC)	ea $22
Car Window Mount	$29
Carrying Case - C8	$179
Counterweight Bar Assem -8" ......$75 11"	$79
Counterweight PB. BKT, C5	$59
Drag Erect Image - 45° 96" .... $42 45° 1 1/4"	$40
45° 96" to 1 1/4" DIAGONAL	$39
DEC Motor (PEC) 8/11, Ultima-C5	$99
DEC Motor C4.5 and SP MT (DC)	$59
Deluxe Lat Adjuster (DLA) C8	$32
Dewstar (Lens Shade - 8")	$24
Advanced Astro Master Computer	$335
Drive C8 Quartz Sing Axis (C8 - Classic)	$195
Expanding Bushing - 96" to 1 1/4"	$13
Filter (All Colors) 2" (Eyepiece)	ea $19
Filters #1A 8 12 15 21 23A 25 38A 47 56 58 80A 82A 96ND 50% 96ND 25% 96ND 13% Polarizer 1 1/4".......ea $10, (6) for	$59
Filter - Series 5 (6 ea. in Set)	$39
Filter Adapter - 96" .... $11 1 1/4"	$15
Finderscope 8x20 for C90-erect image....$54 BKT	$12
Finderscope 5x24 SIG ...$29 6x30	$39
Finder Bracket (Quick Release) 8X50	$42
7x50 III POLAR AXIS Finder	$95
Focus Motor - C8,Classic 8, PWR STAR	$105
Focuser Assy 1 1/4"	$29
Image Corrector - .96 18mm Eyepiece	$15
Lens Pen	$5
LED Flashlight.........$14, DELUXE	$20
Lens Shade - C90.....$53, C5.....$48, C8	$24
LPR Filter(Nebular #2.....$129, #5....$79, ,#7	$89
"A" 1 1/4"..$54,"B" Rear Cell. $79,"C" 2"..$74,"D"(Bin)	$83
Motor Drive-for C4.5 w/Dr Single Ax.(DC)	$250
Motor FS 114/80 (AC)	$79
Motor Drive w/Dr. Dual Axis SP (DC) & GP	$309
Mount G9 Eq. Tripod	$1495
Multiple Ocular Holder 96".....$62, 1 1/4	$119
Photo Tripod Adapter 8" (Opt Tube)	$39
Photographic Tripod Deluxe Slow Motion Controls	$29

CELESTRON

Piggyback Mount 8".......$31, C5....$58 11 14	$54
Piggyback Mount SPC 80 SPC6, SPC 102	ea $21
Polar Axis Finder w/Illum (for C4.5, C6, C80 SP)	$90
Polarizer Set (.96) (Variable)	$31
Polarizing Filter Set - 1 1/4" (Variable)	$42
Porro Prism - 965	$35
Radial Guide Assy Off Axis.....$110, NEB Filter (2")	$75
RFA (Rich Field Adap) F5 (C5/C8)	$89
Refractor Accessory Ring (1 /4" TO 2" Acc)	$18
Reducer/Corrector Lens f6.3	$111
Reducing Bushing = 1 1/4" to 96"	$15
Skylight Filter Dust Seal (5/8/11/14)	$36
Solar Filter - C90 C102 C4.5.....$63, C5	$70
5" Off Axis - C11.....$112, C8.....$99 C60 C80	$38
Sky sensor computer (SP-GP) Motors (Two)	$113
Star Diagonal (.96) .....$18 Star Diagonal 1 1/4"	$38
Diag. RErect 90°	$45
Diag /Barlow Collim 2x, 1 1/4"	$79
Diag. Hybrid 96/1 1/4" 90°	$21
Star Diagonal 2" (Mirror)	$133
Super Polaris Half Pier + (GP)	$131
GREAT Polaris Mt & Tripod with Finder..	$719
T-Adapter C5,C8, C11, C14	ea $23
T-Adapter - C90.......$29, S 80, S-80 +, 80 RFT	$24
T-Adapter Medium Format Camera	$149
T-C 16mm Adapter	$21
Tilt Plate (Wedge) Zero Degrees	$95
Spotting Scope Tripod.......$94, Mini Tripod	$28
Tele Extender- Deluxe.....$42, Tele Extender	$18
TeleExtender - Refractor-Newtonian	$60
ALT. EZT. MOUNT TRIPOD (Photo)	$329
Tripod - Adjustable C5, C8.....$229 mini	$21
Tripod/Wedge (Celestar 8)	$209
C8 Tripod Heavy Duty $249 11/14	$468
VSP (Vibration Suppression Pads)	$38
Visual Back -1 1/4" (Eyepce hldr)...$26, C90 1 1/4"	$29
Wedge - C8.....$85 14	$368
Wedge Up Grade Kit	$99
PUBLICATIONS - BOOKS Sky Maps	$11
Owners Manuals	ea $9
Binocular Buyers Guide Book by Alan Hale	$5
Polar Alignment Kit (for all scopes)	$29
MISCELLANEOUS Peterson Guide	$6
Lens Caps........ea 50¢ Accessory Tray (TRIPOD)	$29
f4 Reducer lens (for 500mm telephoto)	$72
Cassette Tape S/C Oper. of Telescope (Spec. Meade or Celestron)	$6

MISC

Rubber Eye Guard 2"	$8
12 Volt Amp. Batt. Pack & Cgr	$79
Intertec Night Scope	$195
Dew Shield 10" (Vinyl)	$39
Dew Shield C11 (Vinyl)	$49
Nighthawk-Nightscope	$499
Ewa-Underwater Case (35mm Cam.)	$179
Binocular Case (7x35)	$15
Case–Sm. Spotting Scope	$19
Moon Clock (France)	$59
Armillary (Sundial-Sweden)	$199
Carry Case- Sm. Photo Tripod	$19
G8A Eqt. Mt. & Tripod (Pick-Up Only)	$1195
Unitron Eqt. Mount & Tripod	$395
Unitron Electric Motor (102mm)	$195
Unitron Spot. Scope Tri. (Wood W/Ctrls)	$22
DEC Motor (Old C8)	$59
DEC Motor (Powerstar C8)	$119
Rainbow Machine (Elec. Projector)	$59
Zeiss Microscope (Binocular Type)	$795
Kaleidoscope (W/Semi-Precious Crystals) Small	$95
Large	$195
Olympus Camera OM1	$195
Olympus Camera OM10	$219
Light Meter	$19
Olympus Flash Unit	$29
Olympus Zoom Lens (100–200mm)	$95
Olympus 50mm Zukore Lens	$29
Filter Hoya 49mm (Red/Blue)	Ea. $19
Slide Duplicator	$19
Swarovski Giant Binocular Mount	$179
Newton Mounting Blocks for 12 1/2"	$39
DC Powerpack (AC Adpt.)	$15
DC Charger 12 Volt	$15
Piggyback Mount (90mm Refr.)	$35
Bertol 18mm 1 1/4" Eyepeice	$35
Software (Zephyr) Astro Aid, Astrocalc, Astrobase, Cometwatch, Astrostell	Ea. $20
Spotting Scope 50mm & Tripod	$79
Kowa Eyepeice 25mm (TSN)	$70
Lumicon Camera Adpt. 2 1/4"x2 1/4"	$95
HF Filter (UHC Type) 1 1/4"	$69
Lumicon Oxygen 3 2"	$179
Unitron Extension Tube 3" (.96)	$10
Brandon 32mm Eyepiece	$129
Unitron .96 Eyepiece	$32
Unitron Wooden Eyepiece Case (.96)	$20
Bausch & Lomb Window (4" S/C)	$10
Mirror 4"	$40
DEC Motor (S/C Old Style)	$49
Cradle (4" Refl.)	$29
Solar Filter (Hand-Held Mylar)	$1
Handle (35mm Camera) Grip	$10
Unitron Piggyback Bkt 4"	$69
Unitron Uniclamp Solar Proj. Scr	$39
Unitron 3" Piggyback Bkt	$49
60mm Mounting Ring	$10
Battery Pack (Parks) 12Amp.	$49

Inverter 12 Volt-120 Volt ★ Eyepiece Holder .96 ★ Cradle Mt. (1 Pair) ★ 6" Ent Piggyback Cam. Adpt. Assem. ★ Vogel Digitrack Drive Corrector (400 D) ★ JMI DEC Motor ★ Elliptical Mirror & Holder ★ (2) Piggyback Bkts. ★ Chronostar Clock ★ Lumicon Piggyback Mt. (C11) ★ Unitron Illuminator Light for Acc.

★ ★ ★ OFFICIAL ★ MEADE ★ CELESTRON ★ B&L ★ AUTHORIZED O.E.M. SUPPLIER

CELESTRON

C90	$308
60MM EQ	$149
80MM	CALL
DOBS 6" F8	CALL
8" F6	CALL
CELESTAR 8	UNDER $999
CELESTAR 8 COMPUTERIZED	WELL UNDER $1479
CG 9 1/4	UNDER $2449
CG11	UNDER $3400
ULTIMA 9 1/4	UNDER $2249
C5+ WITH TRIPOD	$1199
4½ EQ.	$229
ULTMA 11	UNDER $2899

WHOLESALE OPTICS

STILL THE INDUSTRY LEADERS

SWAROVSKI 7X42 SLC $729
7X50 FMTRSX $454
FUJINON BUY DIRECT & SAVE

MEADE

SCH/CASS 8" f/10 ...$995

with WEDGE SCH-CASSEGRAIN
2080 B O.T.A. M/C 2038MM..$695

NEW MODELS - CALL

QUARTZ DRIVE + 12V DC Adpt.	$78
Tripod (With Purchase)	$179
D.L.A.	$21

ALL MEADE ACCESSORIES IN STOCK

FOR MORE INFORMATION CATALOG — TECHNICAL SERVICE

www.meade.com

WHOLESALE OPTICS DIVISION

MAIL ORDERS TO:
59 MINE HILL ROAD
NEW MILFORD, CT 06776 U.S.A.
TEL: **(860) 355-3132**
FAX : CALL FOR NUMBER (24 HRS)
FAX ORDER LINE ONLY

• PUBLIC WELCOMED • NO SALES TAX COLLECTED •
• SHOWROOMS: 57 NORTH STREET/SUITE 401, DANBURY, CT 06810 •
BUSINESS OFFICES SAT 11 to 5PM •
• PHONE ORDERS 9AM -MIDNIGHT (7) DAYS A WEEK •

Buyers Guide - CATALOGS

JCB BRAVO 3% HOLD FEE VISA

Telescope Accessory Catalog/Data Pack (2lbs)...$10 refundable
Catalog pkg. (Telescopes - Spotting Scopes - Accessories -Binoculars) (3lbs) ..$15
Catalog Charge (Out of USA) .....$29 Minimum shipping Charge (via UPS).....$5 USA
(CT Tax for in state sales only) Minimum shipping - Foreign Orders $29.00

MEADE

NEB Filter from	$49
Photo Guide Bkt.	$29
C.W. Bar Assy N.R.	$35
P.G. (8") NEWT. Bkt.	$35
Filters (.96) (4 Set)	$33
Telescope Covers - Call	

DOBSONIAN
REFRACTOR
REFLECTOR
SCHMIDT-MAK
TELESCOPES

★ SELSI ★ LOSMANDY ★ VIXEN ★ TASCO ★ EWA ★ DELTA BRAND ★ JENA ★ EDMUND ★ SWIFT ★ 1000 OAKS ★ FUJINON ★ STEINER ★ J.M.I. ★ BOWER ★ TIFFEN ★ VOGEL/DIGITRACK ★ JASON ★ UNIVERSITY OPTICS ★

★ ★ ★ MOST ORDERS SHIPPED SAME DAY ORDERED ★ ★ ★ ★ BEST PRICES - CALL US LAST ★ ★ ★ LOOK FOR NEW LOWEST LISTED PRICES ★ ★

BOOKS

The Whole Shebang: A State-of-the-Universe(s) Report

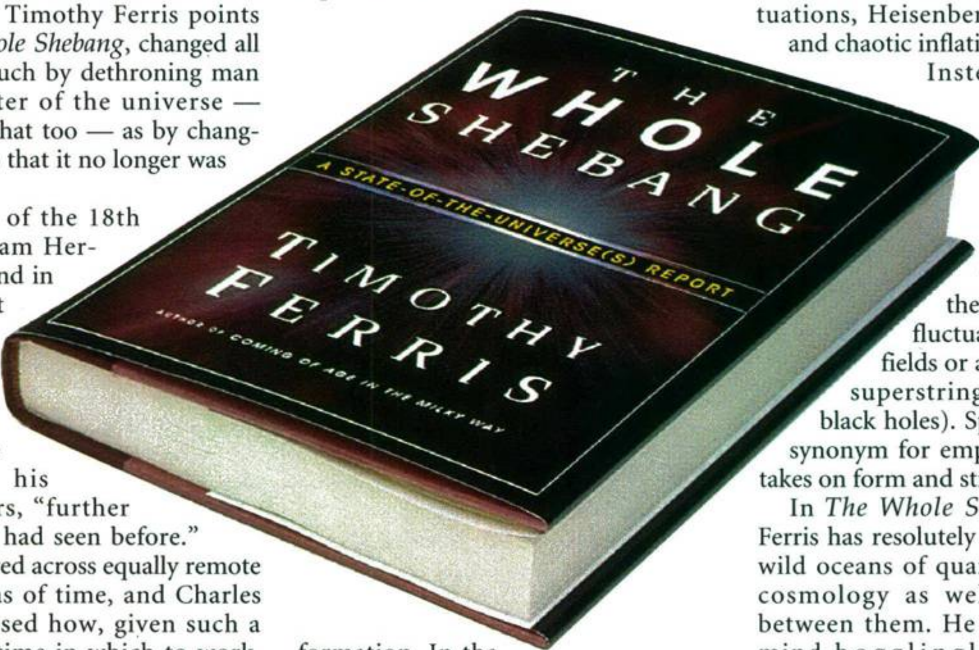
Timothy Ferris, 393 pages, Simon & Schuster, New York, 1997; ISBN 684-81020-4, hardcover, $25.

▶ The medieval universe was smug and self-contained. Through all the misery of life — of plagues and wars and death — there was always the assurance that the world was made somehow for man.

The Copernican revolution, as science writer Timothy Ferris points out in *The Whole Shebang*, changed all that; not so much by dethroning man from the center of the universe — though it did that too — as by changing the story so that it no longer was about us.

At the end of the 18th century, William Herschel dug around in the "luxuriant garden" of the galaxy, opening up the frontiers of space as he looked, with his large reflectors, "further than any man had seen before." Geologists peered across equally remote and hazy vistas of time, and Charles Darwin glimpsed how, given such a vast scope of time in which to work, even the intricate adaptations of living organisms (long attributed to divine design) could arise from the accumulation of contingent accidents through natural selection.

One of Ferris's overarching themes addresses how 20th-century science has extended the evolutionary principle to the known limits of the universe. We have worked out the physics of stars and used the pulsations of some of them to estimate the distances to the galaxies. We have charted their lifetimes from birth in swirling nebulae to death in supernovae — indeed, it is now fairly certain the demise of a star 100 light-years away spawned the birth of our sun and planets 4½ billion years ago. We have studied some of the exotic remains of depleted suns — white dwarfs, pulsars, and black holes. We have charted galaxies sailing past one another, stirring up huge gravitational tides and igniting explosions of star formation. In the seething interiors of galaxies, we have seen where black holes have crumpled the fabric of space-time into Fabergé egg patterns, rapaciously gulping matter while releasing vast torrents of energy.


THE WHOLE SHEBANG
A STATE-OF-THE-UNIVERSE(S) REPORT
TIMOTHY FERRIS
AUTHOR OF COMING OF AGE IN THE MILKY WAY

Conceptually we have cavorted across ever more distant seas aided by the navigating compasses of the laws of physics. Galaxies — appearing to our eyes as vast leviathans sailing across the oceans of space — become, at the level of clusters and superclusters, like minnows in a pond. Ultimately we trace the gigantic structures of the larger universe, a vast froth of vacuous bubbles and walls of galaxies. These structures seem to reflect the foaminess of space-time in the first infinitesimal fraction of the first second of the universe's existence, when the familiar universe of macroscopic dimensions — the staid and steady world of classical physics in which we live — didn't yet exist but instead consisted only of quantum fluctuations, Heisenberg indeterminacy, and chaotic inflation.

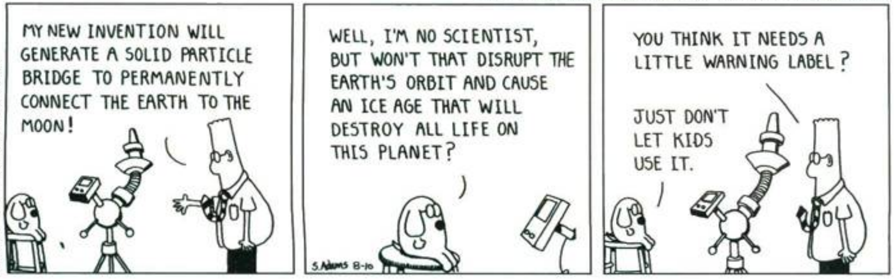
Instead of matter in motion, shuffling endlessly through space, matter itself becomes a sea of subatomic particles, which themselves lose their solidarity in the fluctuations of quantum fields or as the loose ends of superstrings (a.k.a. extreme black holes). Space is no longer a synonym for emptiness but instead takes on form and structure.

In *The Whole Shebang*, Timothy Ferris has resolutely navigated all these wild oceans of quantum physics and cosmology as well as the realms between them. He has taken on the mind-bogglingly challenging task of encompassing, in a relatively slim volume, an encyclopedic range of subjects. He treats everything in the universe and does so in such a way as to make even the most difficult cutting-edge theories of modern physics and cosmology lucidly accessible to the reasonably intelligent reader. There is not a dull page in the book.

Already known as a master expositor of science, Ferris outdoes himself, surpassing even the high mark he achieved in earlier works such as *The Red Limit* and *Coming of Age in the Milky Way*. His work is a tour de force, a spiral galaxy of thoughts recounted in eloquent and vibrant prose.

There is a liberal education within these modest covers. What I say here is but the shadow of a shadow. Read the book under a tree or on the beach, then

DILBERT reprinted with permission of United Feature Syndicate, Inc.


MY NEW INVENTION WILL GENERATE A SOLID PARTICLE BRIDGE TO PERMANENTLY CONNECT THE EARTH TO THE MOON!
WELL, I'M NO SCIENTIST, BUT WON'T THAT DISRUPT THE EARTH'S ORBIT AND CAUSE AN ICE AGE THAT WILL DESTROY ALL LIFE ON THIS PLANET?
YOU THINK IT NEEDS A LITTLE WARNING LABEL?
JUST DON'T LET KIDS USE IT.
S.Adams 8-10

© 1989 United Feature Syndicate, Inc.

reflect on it by moonlight or starlight. Relish its prose, ponder its implications. — *William Sheehan*

Other Books

Time Travel

Paul J. Nahin, 200 pages, Writer's Digest Books, Cincinnati, Ohio, 1997; ISBN 0-89879-748-9, softcover, $16.99.

▶ Written for science fiction writers, this book explains how to send characters traveling through time. Clear and easy to read, the book offers up an arsenal of equations and theories that can be used to construct a fantastic yet scientifically plausible tale. Nahin analyzes the writing of those who know how to tinker with time, such as Isaac Asimov or H. G. Wells. Their styles serve as models to aspiring time-travel writers.

Space Travel

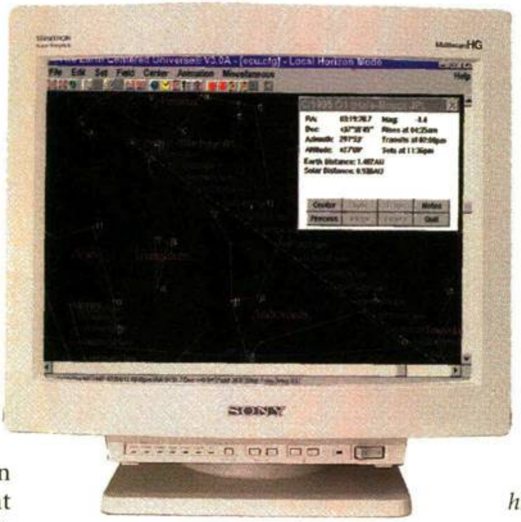
Ben Bova with Anthony R. Lewis, 273 pages, Writer's Digest Books, Cincinnati, Ohio, 1997; ISBN 0-89879-747-0, softcover, $16.99.

▶ Another book in the Science Fiction Writing Series, *Space Travel* explains the science of space for the benefit of fiction writers. Learn the technical data needed to construct an MHD torch ship. Dress your characters in the best space suits available. Build an Earth-orbiting habitat for your story's setting. You can even take a look at the legal and military conflicts your fictional missions might spark. This book supplies the facts needed for solid, believable space-travel fiction writing.

BYTES

The Earth Centered Universe, Version 3.0

▶ *The Earth Centered Universe, Version 3.0 (ECU)* is a shareware planetarium and telescope control software package for Windows 3.1 or 95. The *Yale* and *SAO* star catalogs, with 250,000 stars to magnitude 9.5, and NASA's 15-million-star *Guide Star Catalog* are included. Deep-sky observing needs will be fully satisfied with *ECU*'s database of 10,500 galaxies, clusters and nebulae. The CD-ROM (version 3.0a) includes the *Hubble Guide Star Catalog*.

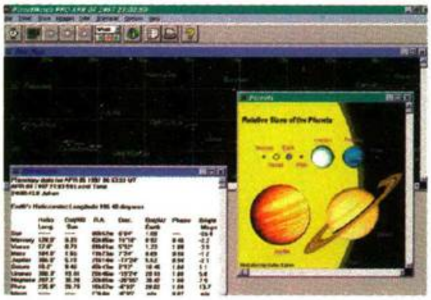


Additionally, *ECU* provides support for the control of several telescopes equipped with computer interfaces, including the Meade LX200 and LXD series of telescopes. It also supports Nova Astronomics's own encoder interface, the "Micro-Guider," which can be built by electronically-inclined amateur telescope makers. The *ECU* website offers an opportunity to view many of the package features.

Nova Astronomics, P.O. Box 31013, Halifax, NS, B3K 5T9 Canada; phone, (902) 443-5989; fax, (902) 445-5790; e-mail, ecu@fox.nstn.ca; website, http://fox.nstn.ca/~ecu/ecu.html. Price: $55 includes shipping. Minimum PC requirements: 486/Pentium PC, Windows 3.1 or 95, minimum 2 MB free memory, mouse.

PlanetWatch Pro

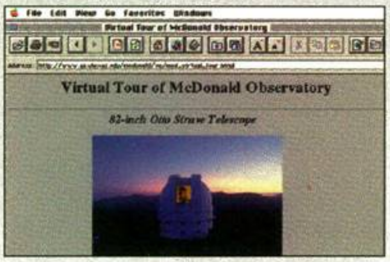
▶ The solar system is the multimedia star of the show for anyone using *PlanetWatch Pro*. Photographs, animated maps, and the latest information from space probes such as Voyager and Galileo are combined into this solar system atlas. Lunar phases are shown, as are the motions of planets and the moon. Orbital and star maps can be set to range anywhere from 1600 to 2400 A.D.



Raben Software & Graphics, 3915 B Street, Greeley, CO, 80634; phone, (970) 302-3715; e-mail, galen@raben.com; website, http://www.raben.com/planet/. Price: $21. Minimum PC requirements: 386 processor running Windows 3.1 or 95, 256 color display, 4 MB RAM, and an available 3 MB hard disk space.

Check out Astronomy*'s home page at http://www.astronomy.com.*

The Webweaver Picks



Virtual Tour of McDonald Observatory

82-inch Otto Struve Telescope

Summer is synonymous with vacation for many people. If touring an observatory while on vacation sparks your interest, have a look at these websites and make time for some star-filled sight-seeing.

Kitt Peak, Tucson, Ariz.
http://www.noao.edu/kpno/kpno.html

Lowell Observatory, Flagstaff, Ariz.
http://www.lowell.edu

Mauna Kea, The Big Island, Hawaii
http://www.ifa.hawaii.edu/mko/mko.html

McDonald Observatory, Fort Davis, Texas
http://www.as.utexas.edu/mcdonald/vc/default.html

Mt. Wilson Observatory, Pasadena, Calif.
http://www.mtwilson.edu/

Palomar Observatory, Palomar Mountain, Calif.
http://astro.caltech.edu/observatories/palomar/index.html

The Very Large Array (VLA), Socorro, N.M.
http://www.nrao.edu/vla/html/VLAintro.html

Yerkes Observatory, Univ. of Chicago, Ill.
http://astro.uchicago.edu/Yerkes.html

A PRODUCTS

Modularized Dobsonians

▶ Telescopes & More offers two open-truss Dobsonian telescopes designed for people who often travel some distance to observe. The 8-inch f/6 and 12.5-inch f/5 *Frequent Flyer Scopes* each tear down into three main components. The primary mirror cell assembly unclips from its mirror box to double as a heavy-duty carrying box. Eight foam-lined aluminum truss tubes stow into a draw-string nylon tote bag. Finally, the mirror box, secondary assembly, base board, and rocker box all stow into a carrying case fitted with luggage latches and carrying handles. The telescopes are constructed from natural or stained apple-ply plywood sealed with several coats of varnish for moisture resistance and protection from ultraviolet light. Both scopes feature Pegasus main optics and JMI/AstroSystems Crayford-type focusers. Total weight of the 8-inch f/6 is 55 pounds; the 12.5-inch f/5 weighs 95 pounds. Each is covered under a five-year warranty.

Telescopes & More, 21025 NW Timber Road, Forest Grove, OR 97116; phone, (503) 531-3920; fax, (503) 531-7992; e-mail, telmor@teleport.com. *The Frequent Flyer Scope*, Version 8-inch f/6: $1,500; Version 12.5-inch f/5: $2,750. Shipping charges are extra.

PRODUCT INFO

Astronomy assumes no responsibility for the product information supplied by manufacturers. Prices are retail and subject to change without notice. Suppliers should send announcements and color photographs to Star Stuff, P.O. Box 1612, Waukesha, WI 53187, or e-mail starstuff@astronomy.com.

Astronomy's Classifieds

This section is open to anyone who wants to buy astronomy-related merchandise. RATES: $1.37 per word. Minimum charge is $14.00 per issue. Prepayment required. Frequency discounts available. All copy is set in standard typography. CLOSING DATE: 5th of the month, three months before the cover date (i.e., March 5th for the June issue). Send your ads to *Astronomy*, Classifieds, PO Box 1612, Waukesha, WI 53187-1612. 1-888-237-4572 ext. 815. M/C-VISA-American Express-Discover.

ACCESSORIES FOR SALE

Binocular viewer kit. Equatorial platform kits. True equatorial dual- axis control for Dobsonians, cameras, small scopes & binoculars. TL Systems, 2184 Primrose Avenue, Vista, CA 92083. tlsystem@ix.netcom.com or http://www.sunspots.com/tlsystems/ (619) 599–4219

Low cost Pyrex and plate glass primary mirrors for Richfield lensless Schmidt Dobsonians and planetary Dobsonians. Optical tube assemblies and parts available at unbeatable prices. Free price list. Starscanner Engineering, 1015 W. Prince Rd., Box D-129, Tucson, AZ 85705.

Meade Telescope cups and caps. Call Switzer Technologies for more information: (708) 841-8592.

BINOCULARS FOR SALE

25X70 Russian binoculars. Brand new! Superb optics! $199.00. Bill (412) 243-1569.

Giant Russian 20x60 binoculars! Breathtaking pinpoint views! Amazing $118.95 each! 25x70: $229.95; 12x45 "Special" $59.95. Pete Rasmussen (501) 362–5670.

BOOKS AND PERIODICALS FOR SALE

Your antique telescope photo/history published in first book of antique telescopes. N.S.A.S., e-mail N46STAR@AOL.COM phone/fax (612) 937–6087.

MISCELLANEOUS FOR SALE

Ancient coin AR Denarius of Augustus Caesar 27 B.C./A.D. 14. Reverse has comet of eight rays. Famous type depicting the comet that appeared at the death of Julius Caesar (rare). $750.00. (919) 774–6253; or e-mail thomas5@wave-net.net

Einstein never owned a telescope. SASE. Quantum Enterprises, 3720 West Maunaloa, Phoenix, AZ 85023.

New theory on the origin of the moon. Explains everything. http://www.spa.net/~mwright

Solar System in scale and color. Set (2) posters 28"x28". One shows planets compared to sun. Other shows sun compared to a red giant star and a super giant. Reasonable $4.75 for the set includes S/H. Send money order to Inland Products Co., P.O. Box 375, Montclair, CA 91763.

TELESCOPES FOR SALE

13.1" Dobsonian, eyepieces, Telrad, filters, Meade focuser, $650.00 plus shipping. Contact Mark (910) 498-2330.

Celestron C8. Fork mount, tripod, accessories including eyepieces, filters, finder scopes, telecompressor. Excellent condition $1,150. (817) 581-7746 or 1 (888) 444-1080.

Meade 6-inch refractor with LXD750 mount, 1697 computer drive, 8x50 finder, eyepiece. Less than 1 year old. Excellent condition. $4,800. Call (910) 282–2462 or email mcsmith@nr.infi.net (North Carolina).

TELESCOPES WANTED

Wanted: no- longer- used telescopes, parts and accessories. Contact Gary Hand, 24045 Sugarcane Ln., Gaithersburg, MD 20882. (301) 482-0000 evenings.

ASTRONOMY®
MAGAZINE

Add your ad to the Internet!

Reach your potential customers on the WorldWideWeb,
24 hours a day, 365 days a year!
Advertise online with **Astronomy** *classifieds.*
Now featuring online classified ads for as little as **$5.00***
**Offered in conjunction with regular print ad.*

Contact A. Blunt at 1-888-237-4572, ext. 303
E-mail: ablunt@kalmbach.com

Kalmbach Publishing Co. 21027 Crossroads Circle
P.O. Box 1612, Waukesha, WI 53187-1612

http://www.astronomy.com

Earth

IN THE AUGUST ISSUE

FIRE!

The US wants to unleash fires on the West, arguing that small blazes now prevent huge conflagrations later.

SEX AND THE LAND

Earthquakes in the Amazon created an amazing diversity of plants and animals.

WEATHER EYE

In Earth's new weather column, meteorologists untangle the mysteries of the jet stream.

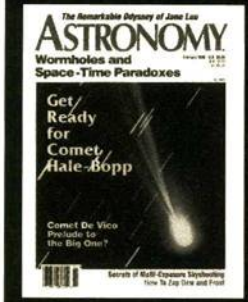
To get your copy of Earth, visit your local newstand or call

1-800-533-6644

Visit our web site at
www.earth.com

From the publishers of
Astronomy®

Reach the worlds beyond Earth


The Remarkable Odyssey of Jane Luu
ASTRONOMY
Wormholes and Space-Time Paradoxes
Get Ready for Comet Hale-Bopp
Comet De Vico Prelude to the Big One?

ASTRONOMY invites you on journeys to Mars, Jupiter and beyond. Find out all about black holes, pulsars, and enigmatic quasars. Learn how the universe really works!

No packing necessary...
but bring your imagination!

To subscribe call
1-800-446-5489
Monday - Friday
8:30 AM - 5:00 PM CT

Kalmbach Publishing Co., 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187-1612

Dept. A797A

CCD IMAGING EQUIPMENT™

- CCD Cameras
- Filter Wheels motor or manual
- ALL CCD Filters
- Flip Mirrors
- Beam Splitters
- 1.25, 2-in. & T-mounts

Equipment for
ALL CCD's
AND visual use.

Flip Mirror - Find & Focus ***Fast***

MURNAGHAN™ Instruments
1781 Primrose Ln., W. Palm Beach, FL 33414
Phone: 561-795-2201 · FAX: 561-795-9889
WWW Catalogs: http://www.murni.com
E-Mail: murni@bix.com

Tell advertisers you saw their ad in ASTRONOMY.

REDSHIFT CONNECTION

BY

S.A. MILIANOWICZ

In early years of cosmological redshift discovery choice had to be made between the phenomena of motion shifts and of photon's energy loss as the cause of these redshifts. Edwin Hubble presents in his book "The Observational Approach to Cosmology" (Oxford Un.Pr.1937) very lucid explanation for velocity-shifts' acceptance as the true sources of redshift. The photon energy loss was, at that time, believed to be:- "some unknown reaction between light and the medium through which it travels" using a quote from p.45 of Hubble's book.

"Redshift Connection" provides quantitative description of gravitational interaction of mass with electromagnetic radiation where the inclusion of gravitational field of the photon, in the calculations, plays a crucial role in the outcome of such interactions.

Specifically, rigorous analysis shows that, if photon's own field is not regarded as being negligibly small, gravity rather than the spacetime expansion is the true cause of cosmological redshift. As a result, a number of presently held physical theories are put in question, not only in the study of astronomy and cosmology, but in all of physics.

Several other, related paradigms are examined in the light of this finding. The prime examples are:- production of long range force; mass duality in its gravitational vs. inertial guise; the source of cosmic background radiation; nature of dark matter. The discussion of these and other topics which impinge on the book's primary subject is supported by rudimentary and fully quantitative analysis. The author contends that the scientifically novel ideas presented in this book, no matter how controversial they may appear, are experimentally verifiable.

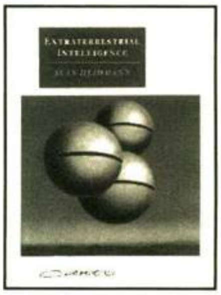
Library of Congress Catalog Card No. 95-81001   ISBN 0-9652987-3-6

Published December 1995 by ARYSUTT AMS
P.O.Box 119, Trafford, PA 15085-0119

242 pages, Price $45.00 plus $3.00 for shipping
MO, PO, or checks payable to: ARYSUTT AMS

Canto

Extraterrestrial Intelligence
Revised Edition
Jean Heidmann
Translated by ***Storm Dunlop***



"Aimed at the general public, it succinctly covers all the important aspects of the field... Heidmann writes in a lucid, agreeable personal style."
— **Nature**

In this engaging book, Heidmann explores both how we should set about detecting extraterrestrials, and what might happen, should actual contact take place. He covers the entire subject of extraterrestrial intelligence and thoroughly discusses the SETI project and all of its implications.

58563-5 Paperback $11.95

Available in bookstores or from

CAMBRIDGE
UNIVERSITY PRESS

40 West 20th Street, New York, NY 10011-4211.
Call toll-free 800-872-7423. MasterCard/VISA accepted.
Prices subject to change. Web site: http://www.cup.org

Astronomy's

Marketplace

AstroBeam
LASER COLLIMATOR

The #1 Laser Preferred by Amateur Astronomers

$175 (w/shipping. US)

★Quick, easy, and accurate collimation for Newtonians ★Exclusive 2 lens 5mW Red laser module ★Tested and Aligned at 100 ft. ★Powerful Diagnostic Tool ★On/Off★ ★Gold anodized ★Fits 1.25 and 2"★ ★AA bat.★ **1 Year Guarantee**★

AstroSystems

FREE CATALOG · $2.00 FORIEGN
HTTP://WWW.FRII.COM/~ASTROSYS
970.587.5838 FAX 587.4613
5348 OCOTILLO CT. JOHNSTOWN, CO. 80534

SOUTHERN SKIES: PERU

- **Travel with local experts through space, history & nature.**
- **Skywatching from the Andes mountain tops.**
- **Ethnoastronomy: Learn the legends and visit the Inca's sites.**
- **Fly over the Nazca Lines: World's largest astronomical calendar.**

write: G.O.A. COSMOS, JR. Emilio Fernandez,
#640, Lima 1, Peru — Fax/Phone: 511-433-8055

OUT-OF-PRINT BOOKS

Rare & out-of-print
books and ephemera on
Astronomy
and related subjects
bought & sold.
Write for free catalogue to:
KNOLLWOOD BOOKS
P.O. Box 197
Oregon, WI 53575
or call: (608) 835-8861
Fax: (608) 835-8421
E-Mail: books@tdsnet.com

METEORITES!

Irons. Stones. Stony-irons. Tekites.
Quality display and study specimens.
Space jewelry, books, slides.
Authenticity guaranteed.
Color Catalog $2.

Bethany Sciences
P.O. Box 3726-A
New Haven, CT 06525

CATCH A FALLING STAR!

(203)393-3395

ASTROVID™
CCD VIDEO CAMERAS

AVA ASTROVID 500E

View the Solar System in Real-Time

- **Complete Systems Start at $365.00**
- No Computer Required
- Save Images to VCR or Camcorder
- Perfect for Large Group Viewing
- Spectacular Celestial Views in Minutes

CCD Imaging Accessories
By True Technology Ltd

Quickly Find, Focus & Center Objects • Filter Viewing & Imaging • Quality Crafted • Affordable

Flip Mirror Finder $239
Flip Mirror Filter Finder ...$329

Also Available
Parfocal Imaging Filter Set 1.25"
R,G,B,IR-Blocking and Clear Glass
48mm Imaging Filter Sets
Various Adapters

ASTRO IMAGING COMPUTER SOFTWARE
Bruce Johnston Superfix $69
IMIPS Advanced Imaging Software $139

Adirondack Video Astronomy
35 Stephanie Lane, Queensbury, NY 12804 USA
Toll Free 888-799-0107 • 518-793-9484 • Fax 518-747-2137
http://ourworld.CompuServe.com/homepages/AVAastro/

Eclipse Cruise '98

~~Reg $1699~~ Our Special **$975***

FEBRUARY 21 ~ 28
7 Days *from* **San Juan**
aboard the new Dawn Princess
includes "Total Eclipse" Lectures
Call **Chris** with Montrose Travel
for more information
(800) 666-8767 or (818) 553-3242
Ask for a free color brochure.

**Per person - cruise only.*

The Kendrick
Dew Remover
System

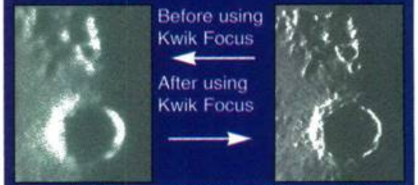
**Heaters for all types of telescopes, binoculars and cameras.
An effective solution for the prevention of dew and frost on your**

controller	$65.00	Telradfinder	$39.00
.965/1.25"	$33.00	**Felt lined flexible Dewcaps**	
1.25/2"	$35.00	ETX	$25.00
2"	$38.00	C5	$32.00
3"	$40.00	6"	$42.00
4"	$43.00	7"/C8"	$50.00
5"	$45.00	C9.25	$55.00
5.5/6.5"	$48.00	10"	$60.00
7/8"	$50.00	C11"	$70.00
9/10/11"	$60.00	12"	$85.00
12"	$70.00	14"	$105.00
14/16"	$80.00	**Batteries, Power supplies,**	
Telrad heater	$23.00	120v converter	$60.00
Computer heater	$120.00	Y adaptor	$10.00
LX200control heater	$35.00	12v17AH Battery	$120.00

Pictured to the left is our 12v 17 amp hour battery. This battery comes fused, with built in cigarette lighter socket, charger, soft but rugged carrying case and shoulder strap. Weighs 14 lbs. **$120.00**

KENDRICK
Kwik Focus
LENS CAPS

A simple and easy to use focusing aid for astrophotographers and observers.
For 8", 10", 11", 12", 14" &16" SCT's.
Now comes with plastic plugs so that the cap can also serve as a lens cap when not in use.



8"	$30.00	12"	$45.00
10"	$35.00	14"	$50.00
11"	$40.00	16"	$55.00

Buy direct or from your favourite dealer

JIM KENDRICK STUDIO
2775 Dundas St. W.,
Toronto, ON M6P 1Y4, Canada
P 416 762 7946 F 416 762 2765
Order line 1 800 393 5456
http://Astronomy-Mall.com
jkendrick@sympatico.ca

The "Go Anywhere" Folding Chair & Table

Ideal for Observation!

Observer Lounge
- folds in seconds
- holds 350 lbs

$64.95 + $5.50 s/h

Chart Table
- top is 32" x 32"
- easy roll up for storage

$39.95 + $5.00 s/h

American Outdoors
All products made in the USA
1-800-336-5208

Major Credit Cards Accepted

Call for catalog!

METEORITES

Michael I. Casper, Meteorites, Inc.
Post Office Drawer J
Ithaca, New York 14851 U.S.A.
Phone: 607-257-5349 Fax 607-266-7904
e-mail: casper@meteorites.com
http://www.meteorites.com

Darkroom Unlimited **The Professionals' Photolab of Choice**

B&W • Color • E6 • Custom Processing
Call for catalog
Visit our web site at www.borg.com/ ~photo
Voice: 800-566-9504 / 315-336-9152
Fax: 315-336-0224

Eclipse Filters Wholesale

ASTRONOMY BY HAND has obtained the remaining stock of Solar and Eclipse Viewers from Starbound and is now making them available to dealers, and organizations for fund raising. The aluminized solar filtering material is the highest optical quality Mylar. Over 180,000 of these same filters were sold for $1 plus shipping in 1994 alone.

- * The viewing area is large enough to view with both eyes at the same time.
- * Complete instructions for the safe viewing are printed on each filter and can not be lost.
- * Custom vinyl protective sleeves to protect the filter material are available
- * Handy pocket size and easier to use and more dignified than the 3D style glasses.

Shipping available to anywhere. Will sell in lots of 1,000, 5,000 and 25,000. Lots over 100,000 available to dealers only. Can accept trades for astronomy related items. Can offer exclusive rights in the US or overseas.

Please contact Gary Hand
301-482-0000 or astroguy@erols.com

DURABLE HIGH-QUALITY COATINGS

With our ENDUROBRIGHT™ COATINGS you will get the most durable and pinhole-free front-surface mirror coatings on the market today! GUARANTEED

- QSP's PROTECTED ALUMINUM coating >89%
- QSP's SEMI-ENHANCED coating >92%
- QSP's ENHANCED coating >96%
- turnaround for PAL mirrors less than 12.5" 7 working days
- turnaround for EAL mirrors less than 12.5" 14-21 working days
- SLAR and High-Efficiency AR coatings upon request
- up to 44-inch diameter
- ENDUROBRIGHT™ dielectric coatings upon request

QSP
QSP Optical Technology, Inc. 1712-F Newport Circle
Santa Ana, CA 92705
Phone: 714-557-2299 • Fax: 714-557-2170
http://www.QSPtech.com

NASA Photo
FOR SALE

We've got an easier way to sell your scope

The Starry Messenger astronomy classified shopper is the largest nation-wide listing of the telescopes and accessories currently for sale by amateur astronomers

Advertise free - pay a 4% commission when successful
Subscribe- $25 for 12 issues
Save $$$ on used equipment
Over 20,000 sales since 1986
500+ current ads each month

The Starry Messenger PO Box 6552-A Ithaca, NY 14851
(201) 992-6865 FAX (607) 277-0018 CompuServe 75020,3120
MC/VISA/DISC Canada - Mexico please send $33 US funds

TOTAL SOLAR ECLIPSE ARUBA FEB. 26, 1998

3:20 totality, longest till 2001.
Aruba, a desert island, almost no cloud cover. Stay at the Aruba Sonesta Resorts at Seaport Village. Aruba is a small island and will sell out fast.

Call for information & reservations
INNOVATIONS IN TRAVEL, INC.
800-733-3361

Buy a Star ★ Name a Star

On the exclusive
MSAS Star Atlas
to be placed in our future observatory & science center.
Receive a certificate of record and more.

Starting at only $30.00!
Free brochure.
VISA/MC accepted
(909) 336-1699

Mtn. Skies Astronomical Society http://www.astro-msas.holowww.com
Box 1169 - Lake Arrowhead, CA 92352

TOTAL SOLAR ECLIPSE • FEBRUARY, 1998
Hole in the Sky Tours presents

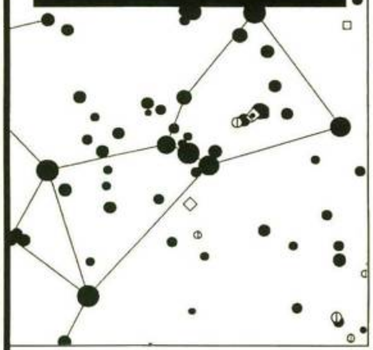
CARIBBEAN CRUISE

Ports of Call include:
Puerto Rico, St. Thomas, Martinique, Barbados, Antigua, & St. Maarten

Giselle's TRAVEL Inc.
ROYAL CARIBBEAN
Monarch Of The Seas

Bask at sea in the "shadow of the moon"
http://home.earthlink.net/~eclipse98/

1-800-782-5545



Did you know that Captain's Nautical Supplies is America's #1 binocular repair service?

Another reason the whole world comes to Captain's: Astronomical Telescopes!

Captain's is known for a lot more than just nautical supplies. Star gazers and serious astronomers from all over look to Captain's for the largest selection of astronomical telescopes and binoculars in the Northwest. See this summer's spectacular skies up close, with precision optics from Captain's.

1(800) 448-2278

Captain's
Nautical Supplies
"The whole world comes fo Captain's!"

2500 - 15th Ave. W.
(One mile south of the Ballard Bridge)
Seattle, WA 98119
(206) 283-7242
Fax (206) 281-4921

Astronomy's

Marketplace

SINGLES NETWORK

Single people interested in science or nature are meeting through *Science Connection.*

Contact us for info: 1-800-667-5179
P.O. Box 188, Youngstown, NY 14174
e-mail: 71554.2160@compuserve.com

SETIQuest®

SETIQuest is a well-established quarterly print periodical containing news, technical information, and tutorials devoted to bioastronomy and its subset, SETI (Search for Extraterrestrial Intelligence). ***SETIQuest*** is published for professionals, serious amateur astronomers and individuals curious about this fascinating field of observation. ***SETIQuest*** fills the need for a specialized astronomical publication devoted exclusively to the ongoing search for evidence of life in the Universe. Such evidence could indicate intentional or inadvertent signals of other civilizations; such evidence could be found in spectral signatures of biological activity on non-solar planets or in the interstellar medium.

SETIQuest is written and edited for the scientifically literate individual taking part in the progress of our technological civilization, with articles by amateur astronomers and professional scientists. ***SETIQuest*** includes information about hands-on observational programs that can be carried out by individuals and groups of amateur astronomers at radio and optical wavelengths. ***SETIQuest*** is filled with articles covering topics such as.

- Tutorials about bioastronomy and SETI.
- Microwave or optical SETI as practiced by amateurs.
- Technical overviews of Project META II (Million-Channel Extraterrestrial Assay) and Harvard University's Project BETA (Billion-Channel Extraterrestrial Assay).
- Book reviews.
- Regular commentary on issues relevant to SETI and bioastronomy.
- SETI and the political agenda.
- Philosophical issues regarding the prospects of success and failure in the search.
- SETI as a parable of science versus pseudo science.
- Publications Watch: Summaries of recent scientific/general publications relevant to SETI.

For your FREE issue of ***SETIQuest*** (Volume 1, Number 1) send us your postal address by fax, e-mail, or conventional mail to:

***SETIQuest* Inquiries, Department AS**
Helmers Publishing, Inc.* 174 Concord St.
Peterborough, NH 03458-0874
Phone: (603) 924-9631 • FAX: (603) 924-7408
Web: http://www.setiquest.com
E-mail: sqinqas@pixelacres.mv.com

Subscription rates $29 One year. $54 Two Years.

METEORITES

ROBERT A. HAAG METEORITES

All varieties.
Authenticity and satisfaction guaranteed.

Send $5.00 for a 64 pg, full-color, all-new *Field Guide of Meteorites.* Cost refundable on first order.

To fax: (602) 743-7225
P.O. Box 27527, Tuscon, AZ 85726

DOUG'S ASTROFILMS & ACCESSORIES

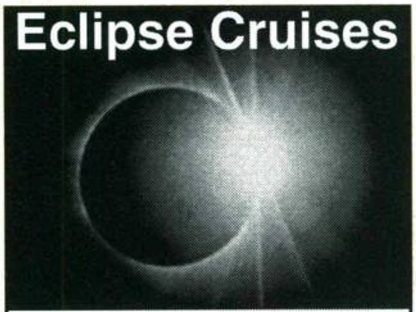
1487 N. SANTA CLARA VIEW DRV., SANTA CLARA, UTAH 84765

FILM	EXP	UNHYPERED	HYPERED
2415	24 *	$6.95	$9.95
2415	36 *	8.95	11.95
T-MAX 400	24 *	6.95	9.95
T-MAX 3200	36	8.95	11.95
PPF-400	36 Color print (new)	9.95	12.95 *
PJM-2-640	36 color print (newest)	9.95	12.95 *
RF-1000	24 Kodak Royal Gold	9.95	12.95
RC-400	24 Kodak Royal Gold	9.95	12.95
CZ-800	36 FUJI-800 color print	9.95	12.95 *
CH-400	24 FUJI-400 color print	8.95	11.95
EL-400	24 Extacrome color slide	11.95	14.95
PL-1600	36 Extacrome color slide	12.95	15.95 *
D-19	1 gal. developer for Technical Pan Film		7.95

*Available in 15 exp. roll, deduct $5/roll

Add Shipping 1.75 first roll, 1.25 each additional roll. Free on 100.00 orders. VISA, MASTERCARD, MONEY ORDER, (1-2 weeks for personal checks), for fax orders 801-673-0795. Include your complete address, card # and type, exp. date and sign. Mon.-Fri. 10:00 am.-6:00pm. MT (Films are not returnable.) Direct inquiries to schmutz@infowest.com. Phone orders 801-632-3384.

Eclipse Cruises



Catch the Eclipse in ARUBA!

1998 Caribbean Sailings
Space Still Available
at Discount Rates

1-800-745-7545

CRUISES CRUISES CRUISES
WORLD CLASS VACATIONS AT SEA
CST#1013661-40

COMMEMORATE
HALE-BOPP

JULLIEN DESIGN
2936 P S BUSINESS CTR DR.
WOODBRIDGE, VA 22192
PH: 1-800 787-1691
FAX: 703 590-4827

***SUNDIALS**
***BOOKENDS**
***PAPERWEIGHTS**
***TEESHIRTS**

PHONE * WRITE OR FAX FOR LIST

NEW AUTHORS

PUBLISH YOUR WORK
ALL SUBJECTS CONSIDERED
Fiction, Biography, Religious, Poetry, Children's.
AUTHORS WORLDWIDE INVITED.
WRITE OR SEND YOUR MANUSCRIPT TO
MINERVA PRESS
2 OLD BROMPTON ROAD, LONDON SW7 3DQ, ENGLAND

Contrast

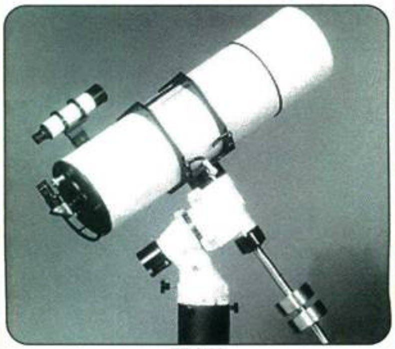
No other eyepiece supersedes **Brandons** for contrast – blacks are blacker, whites are whiter. We manufacture several thousand eyepieces annually at our Candor factory. Try one in your telescope and find out why **Brandons** are considered the finest eyepiece available. 50° field.

1¼-inch Brandon oculars - 8, 12, 16, 24, & 32 mm focal length - $165.00 each.
2" O.D. 48mm Brandon - $295.00 ppd.
The famous 2.4x Dakin Barlow - $125.00.
Filters, Star Diagonals, Barlows, Amici's.
Send $1.00 for flyer.

VERNONscope & Co.
5 Ithica Rd., Candor, New York 13743
Telephone: (607) 659-7000 • Fax: (607) 659-4000

TEC Telescope Engineering

Precision optics up to 60" for amateurs and professionals. Mirror blanks up to 2 meters in diameter. Sitall, Fused Quartz, and other optical materials. Eyepieces and other accessories from Germany and Japan.



8" f/20

Maksutov Telescopes and Optics up to 16" in diameter and focal ratios from f/4 to f/20. Telescope prices from $3300.

Telescope Engineering Company
747 Sheridan Blvd., No 4 B.
Lakewood, CO 80214, USA
Ph. 303 274 7944
Fax 303 274 4115

KITES

FREE COLOR CATALOG

Choose from over 200 exiting kites.

• Many unusual & innovative designs.

Call or write for your catalog today!

Into The Wind • **(800) 541-0314**

1408-A Pearl St., Boulder, CO 80302

NEW! THE VIRGO T&T BINO-MOUNT

The Best Binocular Mount for the Money

NOW ONLY $134.95 + S&H

Mount/Tripod/Bag Package Deal $229.95 + S&H

Visa/MC /AX/Discover Accepted

VIRGO ASTRONOMICS

Call/write for FREE CATALOG &more info.!

Binocular Observing Systems

phone (410) 679-7055

fax (410) 679-2376

608 FALCONBRIDGE DR. STE. 46 • JOPPA, MD 21085

http://Astronomy-Mall.com

LENSES, ACHROMATS & MIRROR BLANKS TELESCOPE COMPONENTS

*** BUY DIRECT * DO IT YOURSELF ***

Stock & Custom unfinished fabricated/molded mirror blanks, diagonals & lenses made from pyrex, optical glasses, fused silica, quartz and other low expansion ceramic materials. Telescope components & scopes. Write, call or fax for free catalog.

NEWPORT GLASS WORKS, LTD.

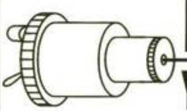
2044-D PLACENTIA AVENUE

COSTA MESA, CA 92627

FAX: (714) 642-4832

(714) 642-9980

www.newportglass.com



BEAM YOURSELF UP

TLC™-201N: The fastest and most accurate alignment and diagnostics possible for Newtonian telescopes.

- Unique holographic reticle speeds alignment
- Daylight 650nm AA battery powered laser
- Compact, fits 1.25" and 2.00" focusers
- Optional adapters for Schmidt-Cassegrain
- Warranty: 2 years parts and alignment
- $195 for TLC™-201N

LaserMax INC.

World leader in diode laser technology

Customers include: NASA, DOD, NATO

Tel: (716) 272-5420

Fax: (716) 272-5427

Toll Free: 1-800-LASER-03

www.lasermax-inc.com

3495 Winton Place, Bldg. B, Rochester, NY 14623

COMET HALE-BOPP

Images now available!

Also: Comets, Hubble,

JPL/NASA, AAO and more!

Send $2 for catalog to:

DARK MATTER IMAGES

P.O. Box 8125 • Goleta, CA 93118-8125

e-mail: mhall@silcom.com

http://www.astrovisions.com

ECLIPSE SHADES™

Safe Solar Viewers

Custom Imprinting Available!

ECLIPSE SHADES
SAFE FOR DIRECT SOLAR VIEWING

Eclipse Shades™ provide the ultimate in protection from harmful Solar Radiation. Lenses made of Optical Grade, Neutral Density 5 Mylar, filter out 100% of Ultra-Violet, 100% of Infra-Red, and 99.999% of Visible Light.

Quality Paper Eyewear & Specialty Optics

Rainbow Symphony, Inc.

6860 Canby Ave. #120, Reseda, CA 91335

1-800-821-5122 FAX (818) 708-8470

E-Mail: eclipse@rainbowsymphony.com

www.rainbowsymphony.com/soleclipse.html

SOFTWARE

We specialize in the best *observing* software. Megastar, Deep Space, PC Sky, Distant Suns First Light, Epoch 2000, SkyPro, and all versions of TheSky . . . among others. Call, write, or fax us today for product catalog AS and your discount price list.

astrosoft

an astronomics company

2401 Tee Circle, Norman, OK 73069

(800) 422-7876 fax: (405) 447-3337

U.S. sales only

VISIT BEAUTIFUL HAWAII

Bring Your Telescopes

For The Vacation of a Lifetime

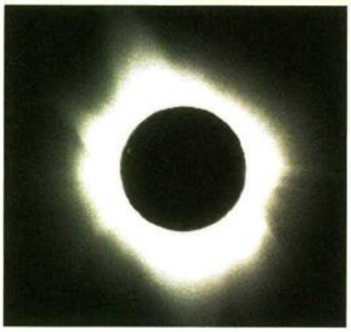
Exciting nighttime astronomy & daytime eco-tour adventures for both serious amateur and novice stargazers. We can arrange it all: Air & ground transportation, lodging, tours, lectures, excursions, meals, cultural & natural activities plus lots of sun & surf. Individuals, couples, families, and clubs welcome!

A GUIDED TOUR OF THE GALAXY

http://www.hoku.com

888/900-4658 Fax: 808/262-3835

PO Box 1013 Kailua, HI 96734



Astronomical League

SPACE IS FILLING BOOK YOUR CABIN NOW!

Caribbean Eclipse Cruise

February 21-28, 1998

Observe the Total Solar Eclipse on February 26, 1998 on **Aruba** at our exclusive, secured viewing site, or go back out to **SEA** on the ship ~ *YOUR CHOICE!!!*

~~~~~~

Special Lecturers include

Fred Espenak,

NASA Goddard Space Flight Center

Mark Littman &

Ken Willcox, co-authors of

TOTALITY, Eclipses of the Sun

Carnival® Cruise Line's

Fascination

SPECIAL ITINERARY:

San Juan ~ St. Thomas ~

Guadeloupe ~ Grenada ~

Caracas ~ Aruba ~ San Juan

$1379 Inside•$1749 Oceanview

(Per person, double occupancy)

$120 per person port taxes

Discounted air add-on available

Carlson Wagonlit Travel

Spears Travel

Local Presence...Global Power

Call 1-800-688-8031 or e-mail:

adele.hitchcock@spears.fabrik.com
~~~~~~

Astronomy's Marketplace

Off-Axis Newtonian Telescopes
Apertures 3.0 - 7.0 inches f/10 Systems.
The OA-Series™
Unobstructed 2-mirror instruments offering exceptional resolution at a fraction of the cost of equal size refractors. Available as a Complete Mounted System, Tube Assembly only, or Optics Sets. Standard or Enhanced coatings
Write: DGM Optics, P.O. Box 88, Stow, MA 01775
Or Call: 508-562-4680 (7 days a week)

BUILD IT YOURSELF

The Smithy 3-in-1 lathe-mill-drill gives you all 3 basic machine tolls for working metal, plastic, or wood in one easy-to-use benchtop machine.

Call for your free Info Pak.

FREE Info Pak

1-800-345-6342
Ask for operator AST7
or write
Dept. AST7 PO Box 1517
Ann Arbor, MI 48106-1517

Smithy

Special Introductory Price

Metro Lite Light

Solid-state Superbright RED L.E.D.

As bright as a regular flashlight with 2 "D" cells

Actual Size
Wt.1/2 oz.

To order, send $14.95* including shipping and handling to:
M & J Enterprises
3405 Cahuenga Bl. West
Los Angeles, CA 90068

or call toll free:
(800) 967-3300

*California residents add 8.25% sales tax.
Please allow 4-6 weeks for delivery.

Ltd. Lifetime Warranty on LED • Maximum Run Time: 6 continuous hrs.
Batteries: (2) A76 alkaline cells • Brightness: 3000 microcandelas • Bulb Life: Approx. 20000 hrs.

STARSPLITTER TELESCOPES
INNOVATIVE DESIGNS IN ALT-AZ

NEWTONIANS
SUPERIOR QUALITY & PERFORMANCE

"EXPERIENCE A NEW UNIVERSE"

MODELS TO FIT YOUR BUDGET

COMPLETE SYSTEMS OR INSTALL YOUR OPTICS

FOR INFORMATION OR COMPONENTS CATALOG CALL OR WRITE:

STARSPLITTER TELESCOPES
3228 RIKKARD DRIVE
THOUSAND OAKS, CA 91362
805-492-0489
PHONE/FAX

STARSPLITTER COMPACT & COMPACT II
8", 10", & 12.5", 14.5"

STARSPLITTER II
12.5" - 30"
STRSPLTR@AOL.COM

METEORITES

Own a piece of another world!

Free 1997 Color Reference Catalogue of Meteorites & Planetary Science products upon request.

New England Meteoritical Services
Box 440-AA, Mendon MA 01756 USA
Tel 508 478 4020 Fax 508 478 5104
e-mail - nemsusa@delphi.com

Don't miss our educational web site.
www.meteorlab.com

ASTRO-PHYSICS

High-quality instruments for discriminating observers and astrophotographers

Refractors- 105,130,155,180mm dia.
German Equatorial Mountings
Visual and Photographic Accessories

155 StarFire EDF with 4" Focuser, 900 German Equatorial 80mm Guidescope, accessories

11250 Forest Hills Rd.
Rockford, IL 61115 USA
Ph: 815-282-1513, Fax: 815-282-9847

FREE LIST OF AVAILABLE SPECIMENS

METEORITES

• Choose From a Wide Variety of Rare, Fully-Guaranteed Inventory

BUY • SELL • TRADE
Southwest Meteorite Lab
P.O. Box 95 • Payson, AZ 85547
Fax 520-474-2474

Tell advertisers you saw their ad in
ASTRONOMY.

REX'S ASTRO STUFF

CELESTRON

Star Hopper 6	$399
Star Hopper 8	$499
80mm f/5 EQ	$299
Celestar 8	$1049
Ultima 2000-8	$2,495

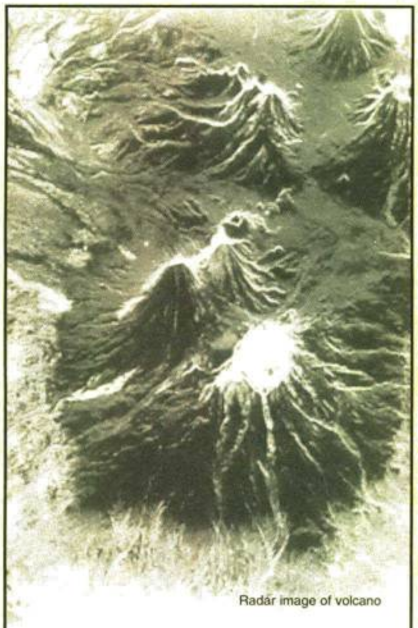
BINOCULARS

10x50 Celestron	$59
20x60 Russian	$119
9x63 Japanese	$199
10x70 Japanese	$319
11x80 Japanese	$389
20x80 Celestron	$349
14x100 Japanese	$1,099

NEW **ASTRO OPTICS**

80mm f/5 OTA	$199
4½" f/4.4 OTA	$189
2.4" Maksutov F/8 OTA	$149
4" Maksutov F/10 OTA	$299
6" Maksutov F/10 OTA	$849
8" Maksutov F/20 OTA (Demo)	$2495
4½" f/8 Dobsonian	$199
90mm f/11 EQ	$499

FREE CATALOG
WORLDWIDE SHIPPING
DEALER INQUIRIES WELCOME
TRADES WANTED
TEL: (501) 331-3773 • FAX: (501) 331-3131
63 Observatory Lane • Dover, Arkansas 72837



Radar image of volcano

Explore the inner mysteries of our world

To subscribe call
1-800-446-5489

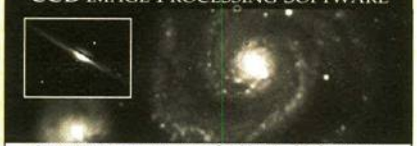
Visit our home page at
www.earthmag.com

Earth

Not the same old view

0124-9702AMCad A77AE

SUPERFIX
CCD IMAGE PROCESSING SOFTWARE



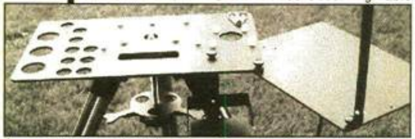
Cameras supported include: **Cookbook, SBIG, Lynxx, Electrim, more. File formats: FITS, TIFF, BMP, PCX**

- **Powerful Image processing with over *80 options*.**
- **Tricolor imaging • Align-and-stack • Slideshow**

Minimum Requirements: 80286, DOS or Windows,
60-day no-questions-asked 100% satisfaction guarantee!!
$69.95 + $4.00 S & H (MI residents include 6% Sales tax). Visa & MasterCard accepted
For more information or to place an order, contact:

Bruce Johnston Computing
7764 Tull Ct. • Waterford, MI • 48327 • 1-810-666-2186
Web page: http://members.aol.com/BJohns7764/BJCfix.htm

Scopesaver Jr. BB200 Observing Table



A complete workstation for **Meade** Telescopes using a standard tripod. Models LX200 (7" 8" 10" 12") LX50 (7" 8" 10") 2080/2100 (8" 10") 2045D & all Meade APO refractors. The 12" x 20" x 1/4" table is CNC milled from aircraft grade aluminum plate and black anodized. It has a precision cross check level to easily level the tripod prior to mounting the scope. Nylon registration guides simplify mounting in the Alt/Az configuration. All you have to do is lean the LX200 against them, and it will be perfectly aligned with the bolt. The BB200 has registers for the LX200 keypad. These provide a secure flat location and allow one hand usage. There are nine 1 1/4" and three 2" holes to eyepiece storage. Accommodates Equatorial and Super wedges. Rounded corners (1/2"R). $99.00 + s/h **Accessories:** Ref table $54.00 Brace $18.00 Bev. hldr. $23.00 Light hldr. $9.00. **ScopeSaver Jr** has locator bumpers and is small enough to be left on the tripod. (for mounting only) $40.00+s/h Visa M/C Amex 5632 Meinhardt Rd., Westminster, CA 92683, 714 893-7749. To order call **1-800 330-8339. Beigle/Bryant Engineering**

SURPLUS SHACK℠
SURPLUS OPTICS AND ELECTRONICS
FREE CURRENT LIST
Phone/fax/faxback TOLL FREE:
1-888-88SHACK • 610-926-9226
E-Mail: SURPLUSHAK@aol.com
WWW: http://www.SurplusShack.com
407 U.S. Route 222, Blandon, PA 19510

TUTHILL,
YOUR ASTRONOMICAL FRIEND SAYS:

Every Meade ETX Scope needs our:
NO DU Cap, Battery Warning Light,
Field Tripod, Solar Skreen,
Piggy Back Mount,
ETX User Video, and Finder.

For info on our custom-made Tuthill
ETX accessories send SASE
9"X12" w/4 stamps to:

Roger W. Tuthill, Box 1086e,
Mountainside, NJ 07092

THE AMAZING DOB DRIVER II

Dual axis microstep quartz drive fits all Dobsonians, or user-built equatorials. Powerful computerized tracking, panning, and guiding in the palm of your hand! Super portable, super simple, AC/DC/CAR/BAT 12V. Instant setup–NO ALIGNMENT! Multi-function display. Calibration supertunes your scope to maximum performance. Options for PC link/CCD link.

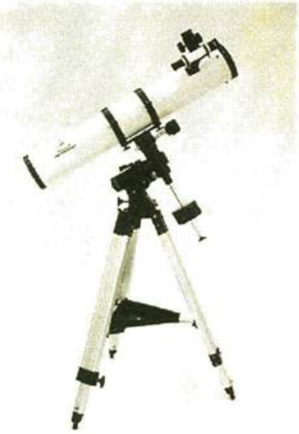
New Roboscope PC Software
Go to 13,000 + objects + any chart point
Control only - $329 ATM System - $439
Complete system w/ready-to-install drives - $549
Free lit - satisfaction guaranteed!

TECH 2000
3349 SR99 S Monroeville, OH 44847
Ph. 419-465-2997 • Fax 419-465-2484
VISA/MC • WORLDWIDE DEALERS

Starsplitter Gem

4.5" f/8 Newtonian Telescope System Features High Quality German Equatorial Mount with Polar Alignment Scope

Aluminum Tripod
1 1/4" focuser
6x30mm Finder
2x Barlow
9mm Kellner Eyepiece
25mm Kellner Eyepiece
Camera Adapter
Lunar Filter



Introductory Price:
$499 + Shipping

Call or Write Starsplitter Telescopes
3228 Rikkard Drive Thousand Oaks, CA 91362
805-492-0489 Phone/FAX
strspltr@aol.com

http//:www.ez2.net/starsplitter

July holds several of North America's most important star parties and astronomical conferences of the year, beginning with **Universe '97 — the Astronomical Society of the Pacific's Annual Meeting**, co-sponsored by *Astronomy* magazine and the ASP, taking place June 27–July 2 in Chicago, Illinois, and **ALCON '97 — the Golden Anniversary Meeting and Convention of the Astronomical League**, July 1–6, at Copper Mountain Ski Resort in Colorado. The end of the month brings the **Mt. Kobau Star Party**, July 30–August 3, at Mt. Kobau, Okanagan Valley, British Columbia, which offers exceptionally dark skies on the mountaintop touted as Canada's best observing site.

Contact your local astronomy club to learn what midsummer delights are in store for your part of the world. *[A listing of Clubs and Space Places can be found on* Astronomy's *website at http://www.kalmbach.com/astro/astronomy.html.]*

JUNE 27–JULY 2
Universe '97
▶ Astronomical Society of the Pacific Annual Meeting, Chicago Hyatt Regency, Chicago, Illinois. Co-sponsored by *Astronomy* magazine and the Astronomical Society of the Pacific. Contact Universe '97, 390 Ashton Avenue, San Francisco, CA 94112, (415) 337-1100, lkeechler@aspsky.org.

JUNE 27–JULY 4
Advanced Teen Astronomy Camp
▶ Mt. Lemmon and Bigelow Observatories, University of Arizona, Tucson, Arizona. Contact (520) 621-7079.

JUNE 30–JULY 1
Symposium on Teaching Astronomy in Community and Small Colleges
▶ Hyatt Regency, Chicago, Illinois. Contact the Astronomical Society of the Pacific, 390 Ashton Avenue, San Francisco, CA 94112, (415) 337-1100.

JULY–NOVEMBER
Sidewalk Gatherings and Star Parties
▶ Several events will be taking place in the Sequoia and Kings Canyon National Parks, Three Rivers, California. Contact Hal Taliaferro, P.O. Box 10, Three Rivers, CA 93271-0010.

Alan Dyer

The warmth of summer draws people out under the stars to observe comets and galaxies. Enhance your appreciation of the heavens by attending a summer star party or convention.

JULY 1–6
ALCON '97
▶ Astronomical League Golden Anniversary Meeting and Convention, Copper Mountain Ski Resort, Colorado. Sponsored by the Denver Astronomical Society, Denver University, American Association of Variable Star Observers, the Royal Astronomical Society, the International Dark Sky Association, and IOTA. Contact ALCON '97, c/o Chamberlin Observatory, University of Denver, Denver, CO 80208-0202, Jerry Sherlin, (303) 680-6894.

JULY 2–AUGUST 27
Summer Observing Sessions
▶ Wednesday evenings, Glen D. Riley Observatory, Springbrook Water Reclamation Center, Naperville-Plainfield Road, Naperville, Illinois. Phone George Simon, Jr., (630) 983-5029.

JULY 3–6
Planetfest '97/Exploring the Art of Space
▶ Pasadena Convention Center, Pasadena, California. Contact Donna Stevens, The Planetary Society, 65 N. Catalina Avenue, Pasadena, CA 91106-2301, (818) 793-5100.

BEGINNING JULY 4
Mars Fest
▶ Adler Planetarium, 1300 South Lake Shore Drive, Chicago, Illinois 60605. Contact (312) 322-0304, 24-Hour Information Line (312) 922-STAR, http://astro.uchicago.edu/adler/.

JULY 4–6
Astro–Atlantik '97
▶ Fundy National Park, Alma, New Brunswick, Canada. Contact Adrien Bordage, 390 Kingsville Road, Saint John, New Brunswick, Canada E2M 4T2, (506) 635-3004.

JULY 4–6
Gateway to the Universe
▶ Powassan, Ontario, Canada. Sponsored by the North Bay Astronomical Society. Contact Tom Ouellette, 221 Mulligan Street, North Bay, Ontario, Canada P1A 3P4, (705) 474-7666.

JULY 4–6
Saskatchewan Star Party
▶ Cypress Hills Interprovincial Park, Saskatchewan, Canada. Contact Erich Keser, Saskatoon Centre, P.O. Box 317, RPO University, Saskatoon, Canada S7N 4J8, (306) 374-4262.

JULY 7–11
Astronomy Camp for Teachers
▶ Mt. Lemmon and Bigelow Observatories, University of Arizona, Tucson, Arizona. Contact (520) 621-7079, dmccarthy@as.arizona.edu.

JULY 14-15

Annual Conference of the Society of Amateur Radio Astronomers

▶ National Radio Astronomy Observatory, Green Bank, West Virginia. Contact Hal Braschwitz, (212) 252-8177.

JULY 25-26

Cedar River Astronomy Club's Star Party

▶ Austin, Minnesota. Contact Keith Snyder, 407 15th Street S.E., Austin, MN 55912, (507) 433-1903.

JULY 25-26

Fifteenth Annual Telescope Making Contest

▶ Parc des Iles de St-Timothée, 35 miles southwest of Montréal, Québec, Canada. Contact Patrice Gérin-Rose, (514) 257-9613, pgr@cam.org.

JULY 25-AUGUST 3

Sixth Annual Star Party and Family Camping Vacation

▶ Shady Pines Campground, 547 Loop Road, Savoy, Massachusetts. Contact the Rockland Astronomy Club, c/o Don Urban, 73 Haring Street, Closter, NJ 07624-1709, (201) 768-6575 (eve.).

JULY 30-AUGUST 2

S.M.U.R.F.S.'97 Star Party

▶ (Southern Michigan Unorganized Regional Festival of Stargazers), Hillman, Michigan. Contact Richard Walker, Robert T. Longway Planetarium, c/o Genesee Astronomical Society, 1310 E. Kearsley, Flint, MI 48507, (810) 760-1181.

JULY 30-AUGUST 3

Mt. Kobau '97 Star Party

▶ Okanagan Valley, British Columbia, Canada. Contact Ann Murphy, P.O. Box 20119 TCM, Kelowna, BC, Canada V1Y 9H2, (250) 764-8478.

JULY 31-AUGUST 2

Table Mountain Star Party

▶ Ellensberg, Washington. Contact TMSP, P.O. Box 785, Puyallup, WA 98371, TMSP@triax.com.

CONTACT

Please submit club announcements four months in advance to Looking Ahead, *Astronomy*, P.O. Box 1612, Waukesha, WI 53187, or to tconley@astronomy.com.

RESOURCES

Ka-Boom! How Stars Explode (Page 44)

Shadow of a Star: The Neutrino Story of Supernova 1987A, by Alfred K. Mann, (W.H. Freeman, 1997). This short book details the discovery of neutrinos from SN 1987A as told by one of the scientists involved.

"Insight into Star Death," by Richard Talcott, *Astronomy*, February 1988. A thorough yet easy-to-understand discussion of Supernova 1987A.

Inflating the Cosmos (Page 38)

Lonely Hearts of the Cosmos, by Dennis Overbye, (HarperCollins, 1991). One of the best books on cosmology, this volume clearly explains the origin and ramifications of the inflationary universe theory.

The Inflationary Universe, by Alan Guth, (Addison Wesley Longman, 1997). Written by the originator of the inflationary universe theory.

Sky Show (Page 66)

Sky Watching, by David H. Levy, (The Nature Company Guides, 1994). Colorful overview on how to get started in observational astronomy.

PHOTOFACTS

PAGE 66: Star Party on Mt. Pinos, California, Tony and Daphne Hallas, 20mm f/2.8 lens, Fujichrome Velvia 50 film, 5-hour exposure.

PAGE 73: Eclipse of Io by Ganymede, May 29, 1991, David Roles, 8-inch f/10 Schmidt-Cassegrain, hypered Technical Pan 2415 film, 5-second exposures.

PAGE 75: M17, the Omega Nebula or Swan Nebula in Sagittarius, Jack Newton, 25-inch f/5 reflector with a cold camera, Kodak Ektachrome 400, 20-minute exposure.

PAGE 78: Pleiades star cluster (M45), Jason Ware, 6-inch f/9 refractor, hypered Kodak PPF 400, 30-minute exposure.

PAGE 79: The Big Dipper (Collinder 285) over Old Faithful, Dewey Vanderhoff, 50mm f/2.8, Ektachrome 400 film, 30-second exposure.

PAGE 80: Brocchi's cluster (Collinder 399), Michael Stecker, 8-inch f/4 reflector, Fujicolor Super HG400 film, 15-minute exposure.

NOW! MORE CHOICES
•Everything Astronomical
•Terrific Bargain Prices
•Expert Personal Service

from Spectra™ Astro • Systems

SPECTRA PROUDLY FEATURES THE FINE ASTRONOMY PRODUCTS OF THESE COMPANIES AND MANY MORE!

CELESTRON CELESTRON INTERNATIONAL
SBIG ASTRONOMICAL INSTRUMENTS
TAKAHASHI
TeleVue
TelRad Optics
LOSMANDY EQUATORIAL MOUNTS
1,000 OAKS
DayStar Filters
PELICAN Protective Equipment Cases
Authorized Meade Dealer
JMI
FUJINON Binoculars
LUMICON
TAMRON
UNIVERSITY OPTICS, INC.

CALL, WRITE OR FAX FOR FREE CATALOG
MON-FRI 9-5 CALIF. TIME
(800) 735-1352
E-MAIL: SpectraAST@aol.com
http://www.rahul.net/Astro-Mall
6631 WILBUR AVE., SUITE 30
RESEDA CA 91335
FAX 24 HRS (818) 996-7698

HOME-DOME®
&
PRO-DOME™

• True Rotating Dome
• 6, 10, 15 ft. Diameter
• Wide Slot Openings
• Easy Assembly
• All Fiberglass
• Complete Systems Priced from $1950

NEW!
DOME-WORKS™
Dome automation system for any motorized dome. $850. Call for info.

Technical Innovations, Inc.
22500 Old Hundred Rd.
Barnesville, MD 20838
301-972-8040
FREE Brochure

Astronomy's

Blue Sky Pages

These pages are specifically designed to be an affordable and highly effective way for dealers to market astronomy-related products or services. Call toll free 1-888-237-4572, ext. 487 to place your advertising message here.

ARIZONA

TUCSON'S COMPLETE ASTRONOMY SHOP

- New and Used Equipment
- Meteorite and Meteorite Jewelry
- Books, Posters, Maps & Star-Charts
- Custom Work-Machine & Wood Shop Work Available
- Observatory Construction & Repair
- Observing site and tour guides available.
- Rental equipment available – call for details.
- Repair Work-Telescope Cleaning & Collimating
- Knowledgeable Professional Staff

SINCE 1986

Stellar-Vision & Astronomy Shop
1835 S. Alvernon #206
Tucson, AZ 85711
(520) 571-0877

Credit Cards accepted. 90 Days same as cash
http://www.theriver.com/stellar_vision

THE ASTRONOMY SHOPPE

- Telescopes • Spotting Scopes
- Binoculars • Maps • Books
- Eye Pieces & Acces.
- "Bigfoot" Mounts
- Custom Optics

15836 N. Cave Creek Road
Phoenix, AZ 85032
602-971-3170

CALIFORNIA

15th Annual Winter Telescope Demonstration, Star Party & Sale
Sun., Nov. 3rd - Sun., Nov. 17th
Sat., November 9th, 10am-10pm
Celestron, Zeiss, L-5. Meet the Reps.
Sat., November 16, 10am-10pm
Meade & Bushnell. Meet the Reps.

OPT

Oceanside Photo & Telescope
1024 Mission Ave., Oceanside, CA 92054
(619) 722-3348 • (800) 483-6287
E-mail: opt@optcorp.com
http://www.optcorp.com

FLORIDA

SARASOTA CAMERA EXCHANGE & VIDEO CENTER
1055 South Tamiami Trail
Sarasota, Florida 34236

TELESCOPES

Meade APD • Celestron • Tele Vue®
Large Accessory Inventory • Used Telescopes
Astrosystems Telescope Components
Software Bisque • JMI Accessories

BINOCULARS

B & L • Bushnell • Celestron • Leica • Meade
Minolta • Nikon • Pentax • Steiner

Cameras, Lenses, Flash
New & Used Photo
& Video Accessories

(941) 366-7484 Call or write Chuck, our dedicated astronomer.

GEORGIA

Telescopes • Binoculars
Accessories • Spotting Scopes
Maps • Books • Eyepieces

Canon • Celestron • Fujinon • Meade
Minolta • Nikon • Orion
Pentax • Tele Vue®

Consignments Welcomed

WE SHIP ALMOST ANYWHERE

Camera Bug Ltd.

1799 Briarcliff Rd. • Atlanta, GA 30306
(404) 873-4513 • FAX (404) 873-3925
ORDERS ONLY 800-545-8509
cam_bug@msn.com
Minutes from downtown Atlanta

Tell advertisers you saw their ad in ASTRONOMY®

NEW MEXICO

BEFORE YOU BUY
COME TO THE COUNTRY TELESCOPE STORE AND TEST EQUIPMENT UNDER DARK SKIES.

Telescopes • Eyepieces • Mounts • Accessories
On-Site Observatory • Regular Star Parties

Meade LX200 Pilot Plates for quick, easy set-up

CELESTRON • MEADE • TELE VUE®
PARKS OPTICAL • UNITRON • HOME DOME

NMA **NEW MEXICO ASTRONOMICAL**

834 N. GABALDON RD • BELEN, NM 87002
(505) 864-2953

NEW YORK

BERGER BROS.
CAMERA EXCHANGE

TELESCOPES • BINOCULARS • CAMERAS • CAMCORDERS
Over 45 years in business.

BERGER BROTHERS
CAMERA & VIDEO EXCHANGE
-Reliable Service-
209 Broadway • Amityville, NY 11701
Info: (516) 264-4160 • **Orders:** 800-262-4160
Fax: (516) 264-1007

NORTH CAROLINA

BALL PHOTO

Celebrating 100 Years of Continuous Business

- **Telescopes – All Sizes • Spotting Scopes**
- **Binoculars – All Makes • Eyepieces, Camera Adaptors, & Accessories**
- **Lowest Prices • Trade-ins Accepted**
- **We Ship Anywhere • In-Store Repair Shop**

Mail & Telephone Orders Welcome

Oldest & Largest Camera Store in the South
When you come to see the Great Smokie Mts., Mt. Mitchell, Cherokee Indians, or the Biltmore House — come see us!
Major credit cards honored
Everything in Cameras & Optics
85 Tunnel Road, Asheville, NC 28805
(704) 252-2443 FAX (704) 253-1457

OREGON

NURNBERG SCIENTIFIC
6310 S.W. Virginia Ave.
Portland, Oregon 97201

Call Stan, our astronomy enthusiast, for expert personal assistance in choosing a fine Tele Vue®, Meade, Celestron or Orion telescope and accessories.

We also carry our own full line of microscopes.

(503) 246-8297
Hours: Monday - Friday 8:30 to 4:30

Astronomy's

Blue Sky Pages

TEXAS

Analytical Scientific
"The Source For All Your Astronomy Needs"

TELESCOPES
Schmidt-Cassegrain • Refracting • Maksutov • Dobsonian
We can computerize ANY scope!
Meade • Celestron • Tele Vue • JMI • Bushnell
Binoculars • Spotting Scopes • Laser Sight
Celestron • Selsi • Swift • Bushnell • Meade

MICROSCOPES
Swift • Eagle • MBC
Educational kits for schools also available!
11049 Bandera Rd.,
San Antonio, TX 78250
(210) 684-7373 • fax: (210) 520-3344
EMAIL: 103100.752@Compuserve.com
To see the STARS call: 1-800-701-STAR (7827)
Visit us on the ASTRONET:
http://www.rahul.net/Astro-Mall

WISCONSIN

Telescopes, Binoculars, & Accessories

Celestron, Meade & TeleVue
Telescopes & Accessories
in stock!
Discounted Prices
Shipping Nationwide

Discount Price List & Comprehensive Catalog
EAGLE OPTICS
716 S. Whitney Way - Madison, WI 53711 (608) 271-4751

CANADA

MEADE APD PRODUCTS

CANADA-WIDE DELIVERY!
TRADE INS WELCOME
BUY/SELL USED

Celestron • Meade • Tele Vue • Omcon
Bausch & Lomb • JMI • Kwik Focus • Kendrick
Lumicon • SBIG • Fujinon • Telrad • Thousand Oaks
Sky Publishing *and many others!*

FREE LITERATURE

KHAN SCOPE CENTRE
TEL: (416) 783-4140 FAX: (416) 783-7697
3243 Dufferin Street, Toronto, Ont. Canada M6A 2T2

SKY OPTICS

Quality Telescopes, binoculars, eyepieces, CCD's accessories, books, computer software and more....

Lowest Prices *Expert Advice * Best Service * Canada Delivery

Meade, Tele Vue, Celestron, SBIG, Lumicon, Kendrick, Software Bisque, and more!
(905) 631-9944 4031 Fairview St., Burlington, Ontario L7L 2A4
http://worldchat.com/commercial/skyoptics/

CANADA

EfstonScience
Canada's Largest Retail & Mail Order Astronomy Dealer
SERVING OBSERVING SINCE 1970!
Just look for the giant telescope on our roof!

Free literature
ALL MAJOR BRANDS ON DISPLAY
MEADE APD
Advanced products
CELESTRON
Dobsonians in stock 6" – 16"
Welcome trade-ins, buy used, and do repairs

3350 Dufferin St., Toronto, Canada
Ph: (416) 787-4581 FAX: (416) 787-5140
Web site www.efstonscience.com

HARRISON
Scientific Instruments, LTD.
Serving Canadians for over 135 years
Telescopes, Binoculars, etc.
• Celestron • Meade • TeleVue • Bushnell
• Pentax • Zeiss • Steiner • DryEye dew control systems
Fast Canada-wide Delivery
Vancouver
(604) 737-4303 • FAX (604) 737-4390
2574 Granville Street • Vancouver, B.C. V6H 3C8

EUROPE

Future Games

USA prices in Europe!
INTELLIGENT DRIVE SYSTEMS
Equatorial Platforms - Accessories
Telescopes - Computers

Everything astronomical except the prices!

AstroSystems
New technology truss tube telescopes 250mm-760mm
Custom equatorial mounts-Opticraft motor drives-Telrads
Jim's Mobile Inc. - NGC Max Computers - Motofocus - NGF Focusers

FOR ALL DOBSONIANS

Put an end to frustrating starhopping. Spend more time observing and less time hunting for objects. These computer units can easily guide you to any of hundreds or even thousands of objects. You don't have to know where they are or even have a star chart handy.

Yes! You can have all the convenience of a Dobsonian married with the dead-on tracking of an equatorial!

TECH2000
THE AMAZING DOB DRIVER II

Software and CD-ROM Catalog
The Sky vers.4 - Megastar vers.3 - DeepSpace vers.5 - Redshift

Tel: (352) 40 50 52 Fax: (352) 40 65 09
E-mail: futuregames@luxembourg.com
24, rue de Strasbourg, Luxembourg

Advertise in ASTRONOMY'S "Blue Sky Pages."

KEEP YOUR CUSTOMERS IN THE DARK.

It's an easy, cost-effective way to reach the largest active audience of stargazers in the world!

Call Pam Hagan toll-free
1-888-237-4572, Ext. 487
for more information.

COMING IN THE

AUGUST 1997

ISSUE OF

Astronomy®

USGS

THE ONCE AND FUTURE MARS

Evidence suggests that life may once have existed on Mars. Now scientists ponder where to search for proof. *Astronomy* also looks at the challenges to future human missions to the Red Planet.

A UNIVERSE IN THE LAB

Alan Guth, who developed the theory of inflation that helps explain the universe's origin, examines whether an advanced civilization could create its own universe.

HOW TO BUY BINOCULARS

A good pair of binoculars is invaluable to anyone who watches the sky. Here's all you need to know to make an informed purchase.

GRAVITY'S RAINBOW

Einstein predicted that massive objects could bend light. Astronomers now use these gravitational lenses to probe the distant universe.

AVAILABLE JULY 8

For subscription information, call (800) 533-6644.
Kalmbach Publishing Co.
P. O. Box 1612, Waukesha, WI 53187-1612

Visit our Web page at http://www.astronomy.com

A52A

AD INDEX

Adirondack Video Astronomy .112
Adorama .98, 99, 131
American Outdoors .112
Analytical Scientific .121, 131
Astro-Physics .115
Astronomics .21, 33, 114
Astronomy Shoppe .120, 131
Astrosystems, Inc .112
Ball Photo Supply .120
Beigle/Bryant Engineering .117
Bergen County Camera .131
Berger Brothers Camera Exchange .120
Bethany Sciences .112
Blue Sky Pages .120, 121
Bruce Johnston Computing .117
Cambridge University Press .111
Camera Bug .120, 131
Captain's Nautical Supplies .113, 131
Michael I Casper Meteorites .113
Celestron International .31, 134
Cruises Cruises Cruises, Inc. .114
DGM Optics .116
Dark Matter Images .114
Darkroom Unlimited .113
Day Star .27
Doug's Astrofilms & Accessories .114
Dover Photo Supply .131
EKV Productions, Inc. .115
Eagle Optics .121, 131
Edmund Scientific Company .33
Efstonscience, Inc. .121
FC Meichsner Company .131
Focus Camera .35
Fujinon .20
Future Games .121
G O A Cosmos .112
Giselle's Travel .113
Gary Hand .113
Harrison Scientific Instruments, Ltd .121
Helmer Publishing .114
Innovations in Travel .113
Into the Wind/The Kite Source .115
JMB Inc .20
Jim Kendrick Studios .112
Jim's Mobile Industries .23
Jullien Design .114
Kalmbach Publishing Company .64, 102, .104, 106, 111
Khan Scope Centre .121
Killgore Southwest .115
Kitt Peak National Observatory .17
Knollwood Books .112
Lasermax, Inc. .115
Lumicon .76, 77, 131
M&J Enterprises .115
Marketplace Pages .112, 113, 114, 115, 116, 117
Meade Dealer Pages .14, 15
Meade Instruments Corp .2, 3, 7, 8, 9, 10, 11, 12, 13
S. A. Milianowicz .111
Minerva Press .114
Montrose Travel .112
Mountain Skies Astronomical Society .113
Murnaghan .111
New England Meteoritical .116
New Mexico Astonomical .120
Newbridge Communications, Inc. .19
Newport Glass Works .115
Nurnberg Scientific .120
Oceanside Photo & Telescope .120, 131
Orion Telescopes & Binoculars .29
Pocono Mountain Optics .36, 37, 131
QSP Optical Technology, Inc. .113
Rainbow Symphony .115
Rex's Astrostuff .116
Rivers Camera Shop .33
Robert A Haag-Meteorites .114
Santa Barbara Instrument Group .25
Sarasota Camera Exchange .120
Science Connection .114
Scope City .20, 131
Shutan Camera & Video .65
Sky Optics .121
Smithy .116
Software Systems Company .27
Spears Travel .115
Spectra Astro-Systems .119
Starry Messenger .113
Starsplitter Telescopes .116, 117
Stellar Vision .120, 131
Surplus Shack .117
Tech 2000 .117
Technical Innovations .119
Tele Vue Optics, Inc .132, 133
Tele Vue Dealer Page .131
Telescope & Binocular Center .94, 95
Telescope Engineering .114
Roger W. Tuthill, Inc. .33, 105, 117
University Optics, Inc. .105
Vernonscope .114
Virgo Astronomics .115
Wholesale Optics .107
Zephyr Services .27

COMETWATCH

Hale-Bopp's Special Delivery

Years of patient waiting finally pay off.

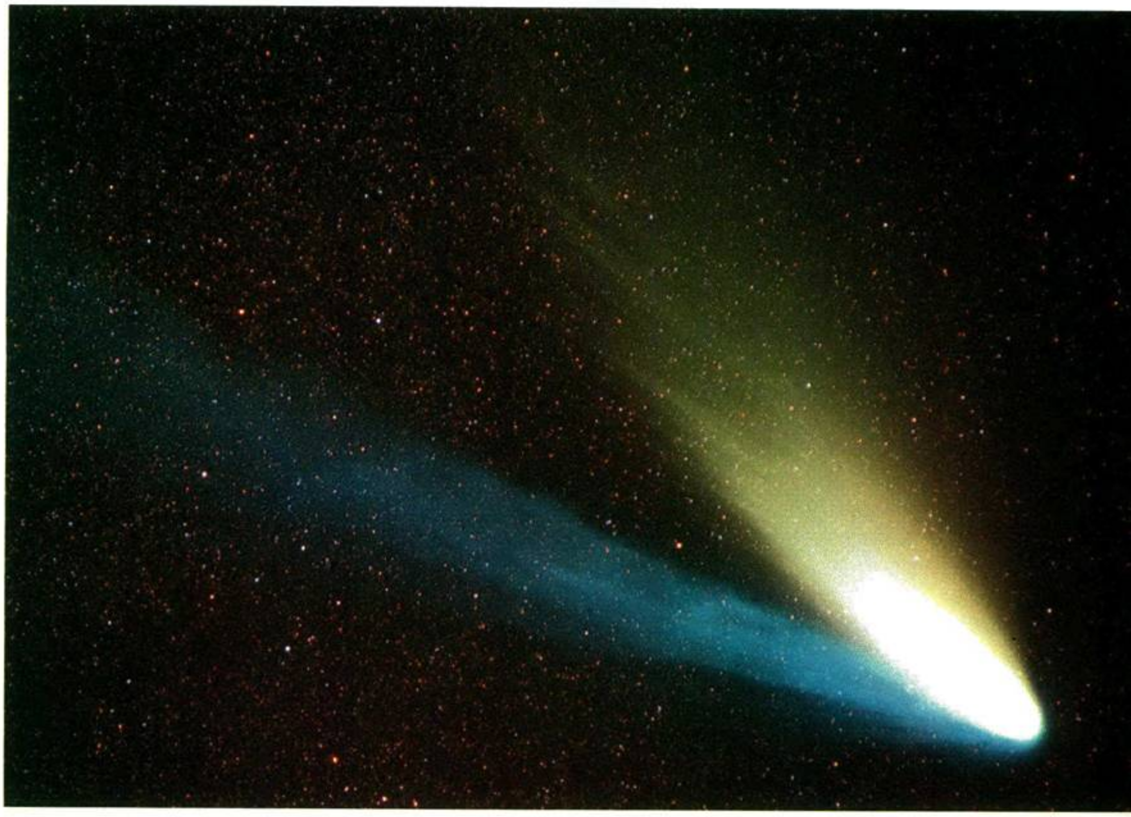
▶ Hale-Bopp has made it cool to like comets again. Even after last year's Comet Hyakutake, comets were looked upon largely as letdowns, synonymous with words like "fizzle" and "disappointment." All through fall and into winter, hopes for Hale-Bopp were couched in this mindset, with caveats like "if predictions hold."

But for the second time in as many years, the sky delivered. By February, it was obvious Hale-Bopp wasn't going to be a flop. As it passed closest to the sun on April 1st, the comet shone at around magnitude −1 and sported a dust tail nearly 20° long.

"Hale-Bopp was a perfect comet for couch potatoes," says San Francisco native Jim Shields. "You just had to walk out your front door and there it was. No effort was required."

Brooklynite John Pazmino got his first look at the comet on March 10 while commuting home by train through the heart of metro New York. "When it got dark enough to see the comet, I got off at the nearest station," he relates.

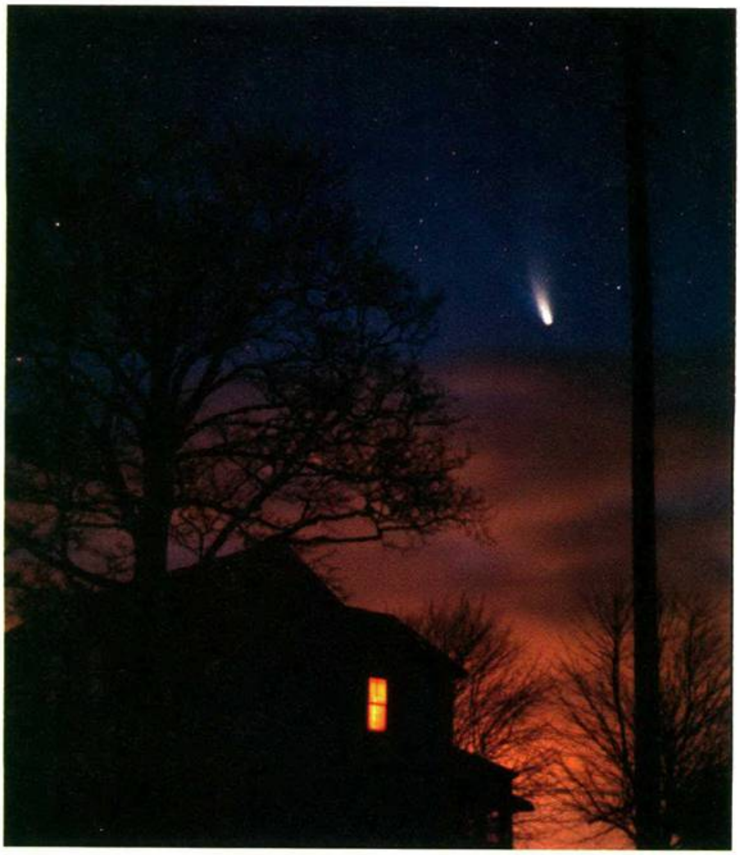
Pazmino found a vantage point with a clear view to the north and west, where he found "Hale-Bopp twinkling like any other bright star." After taking a few minutes to estimate a tail length of ½° and a brightness slightly dimmer than Capella,



Hale-Bopp's Dust and Ion Tails

JOHN S. EBERSOLE

(400mm lens at f/4, medium-format camera, Kodak Pro PPF 400 film, 15-minute exposure taken on March 16, 1997)



Predawn Hale-Bopp over a Farm House

GLENN F. KNARR

(50mm lens at f/1.7, Fujicolor Super G 800 film, 12-second exposure taken on March 16, 1997)

Pazmino boarded the next available train to continue his commute home.

In Altadena, California, Bryan Allen turned being woken up by a cat into an impromptu predawn Hale-Bopp observing session. "It took about three seconds to find it," he says, "even with the neighbor's 'insecurity' lights shining in my eyes." After taking in the comet's hook-shaped coma and twin tails, Allen felt compelled to rouse his wife for a view.

"Given that I've been inflicting comets and other sky sights on her since Halley in 1986," says Allen, "her comment was a classic: 'That's the first comet you've ever shown me that looks like a comet.'"

Other non-astronomers greeted the quintessential comet with the Albuquerque Astronomical Society, who invited people to a "Be-Bopp" on March 29, complete with 77 scopes. "An official count of 13,500 people came from the Rio Rancho police department, who managed traffic control for us," says club president Mike Pendley. He credits the city of Rio Rancho with preparing the star party site and the University of New Mexico for providing graduate students to help operate scopes and answer the public's questions.

Perhaps the most honest comet observations came from younger observers. Terry Pundiak of Easton, Pennsylvania, mentions how a neighborhood boy likened Hale-Bopp to a "furry star with feathers." Ron Westmaas's niece of Catcott, England, saw a "moon wearing a scarf."

As Hale-Bopp continued to brighten into April, people who were not even going out of their way to see the

A Moonlit Desert Cloud Chases the Comet

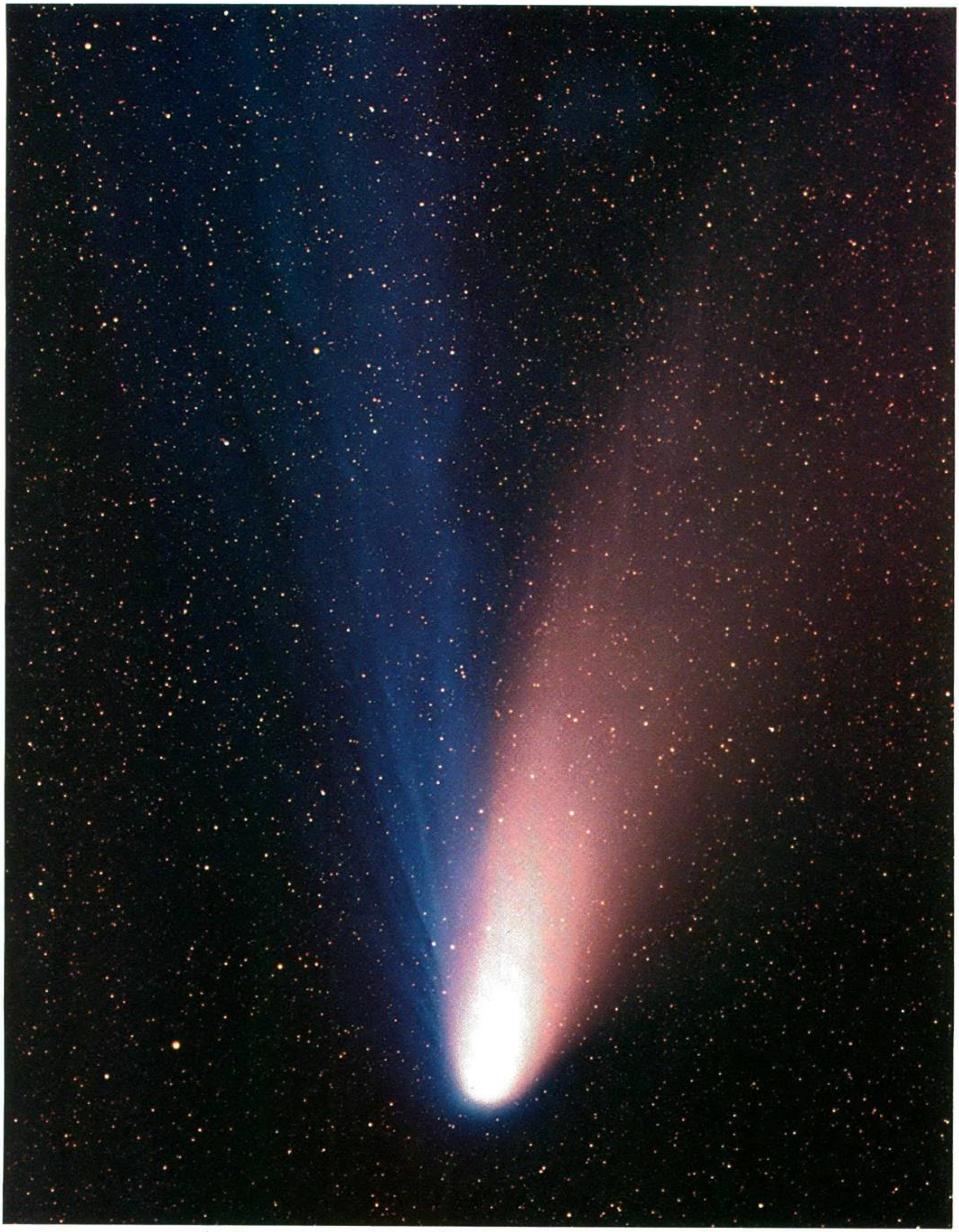
JERRY SCHAD

(200mm lens at f/2.8, Kodak Ektachrome P1600 film, 15-second exposure taken on March 24, 1997)

The Comet over the Kansas City, Kansas, Skyline

DOUGLAS ZUBENEL

(135mm lens at f/2.8, Fujicolor Super G 800 Plus film, 5-second exposure taken on March 9, 1997)



Comet Streamers and the Inner Coma

BILL AND SALLY FLETCHER

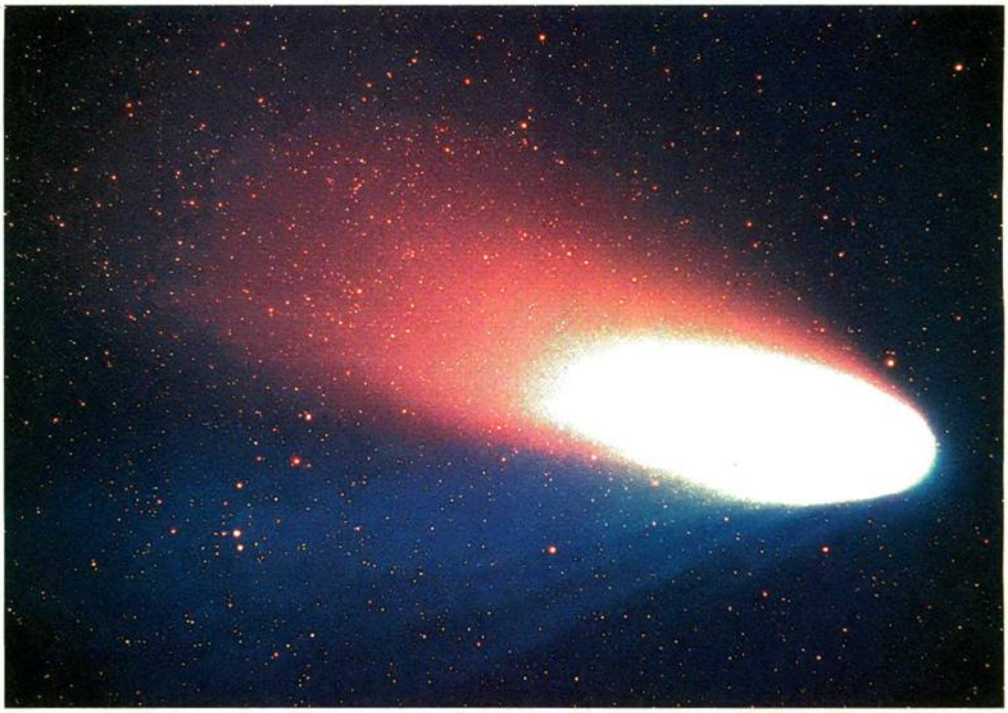
(8-inch f/1.5 Schmidt camera, Kodak Pro 400 PPF film, 4-minute exposure taken on March 8, 1997) visitor caught comet fever. In Minneapolis, Minnesota, Ron Howes was glancing at Hale-Bopp over his neighbor's roof when the driver of a van leaned out his car window to say the comet was "a heck of a sight." "At that moment," says Howes, "astronomy didn't seem such a solitary hobby."

The comet's climb in brightness brought with it some rich detail in the inner coma, including a complex series of hoods. These hoods were caused by jets that became active as Hale-Bopp's rotating nucleus brought them into sunlight every 11 hours or so. Each squirt sent a fresh batch of dust and gas into space to create a new hood. Subsequent hoods piled up to create a concentric arrangement around Hale-Bopp's inner coma.

The enigmatic features were easy targets for backyard observers, even in modest telescopes. Dave Nash of Champaign, Illinois saw the hoods at 21x in his 4½-inch reflector, while Brian Rachford in Laramie, Wyoming, glimpsed them through a 60mm refractor working at 39x.

As you read this, Hale-Bopp has crept from Earth's skies to begin another multimillennium trip back into interplanetary space. What other comets lurk out by Hale-Bopp's environs? Only time will tell. One thing's for certain, though — the comet drought is officially over, thanks to a deep-space visitor called Hale-Bopp. ▣

Send reports, stories, sketches, photographs, and disks to Hot Shots Editor, Astronomy, *P.O. Box 1612, Waukesha, WI 53187-1612. Send written reports and electronic images via the Internet to: hotshots@astronomy.com.*



Hale-Bopp's Dual Tails

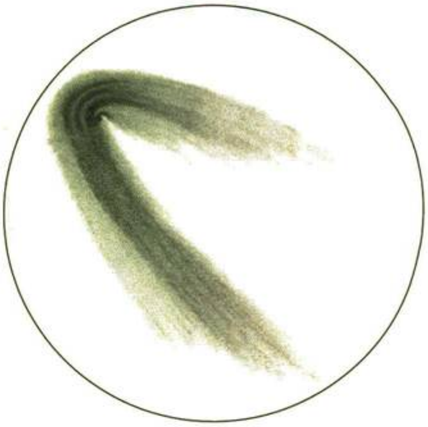
CARL WEBER

(5-inch refractor at f/4.5, Fujicolor 800 Plus film, 15-minute exposure taken on March 1, 1997)

The Comet over Sonoita, Arizona

PHILIP C. FARNAM AND JAMES MCGAHA

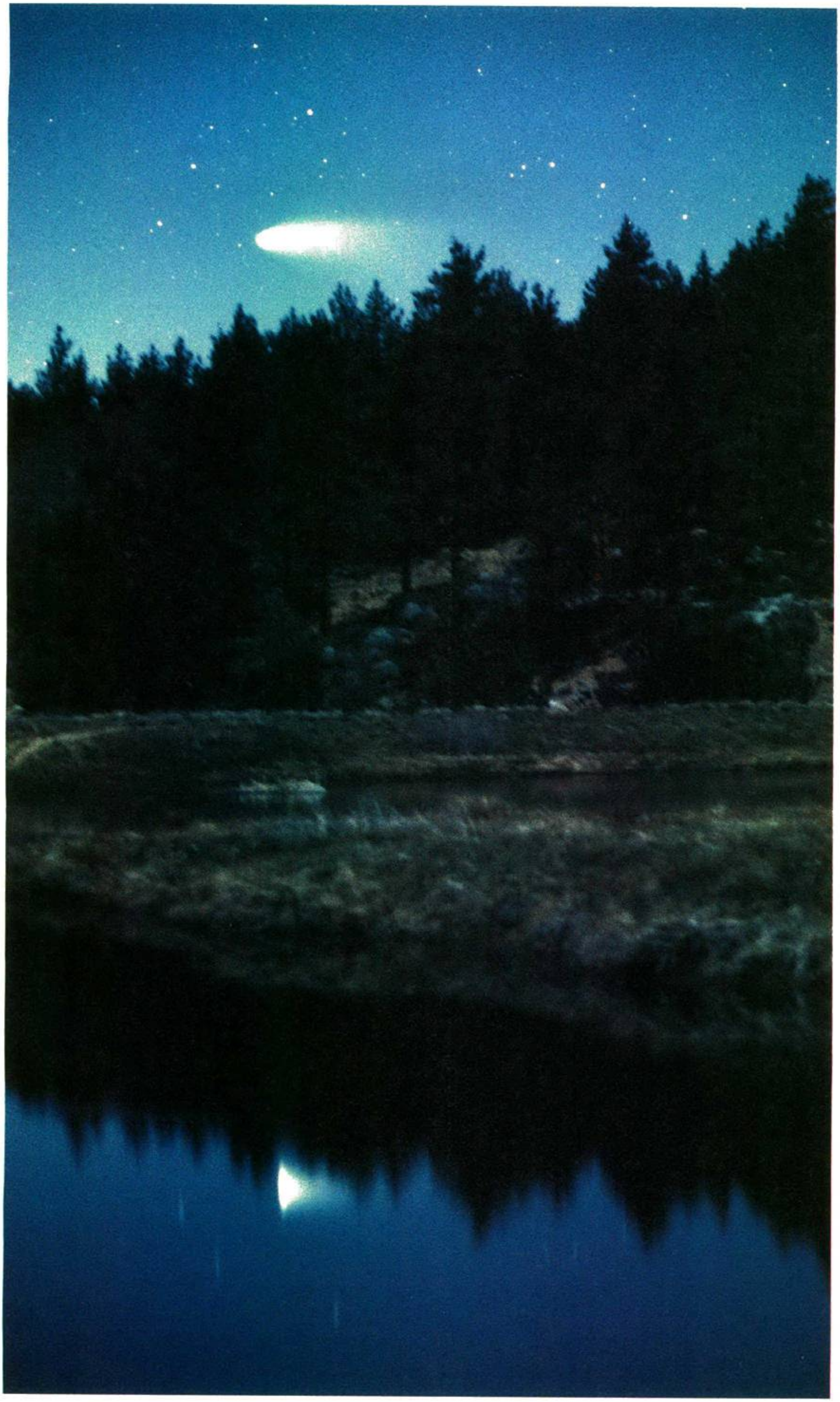
(400mm lens at f/2.8, Fuji 800 Super G film, 15-minute exposure taken on March 12, 1997; winner of a Kitt Peak National Observatory photo contest.)



Hoods and Streamers around the Inner Coma

RICHARD DIDICK

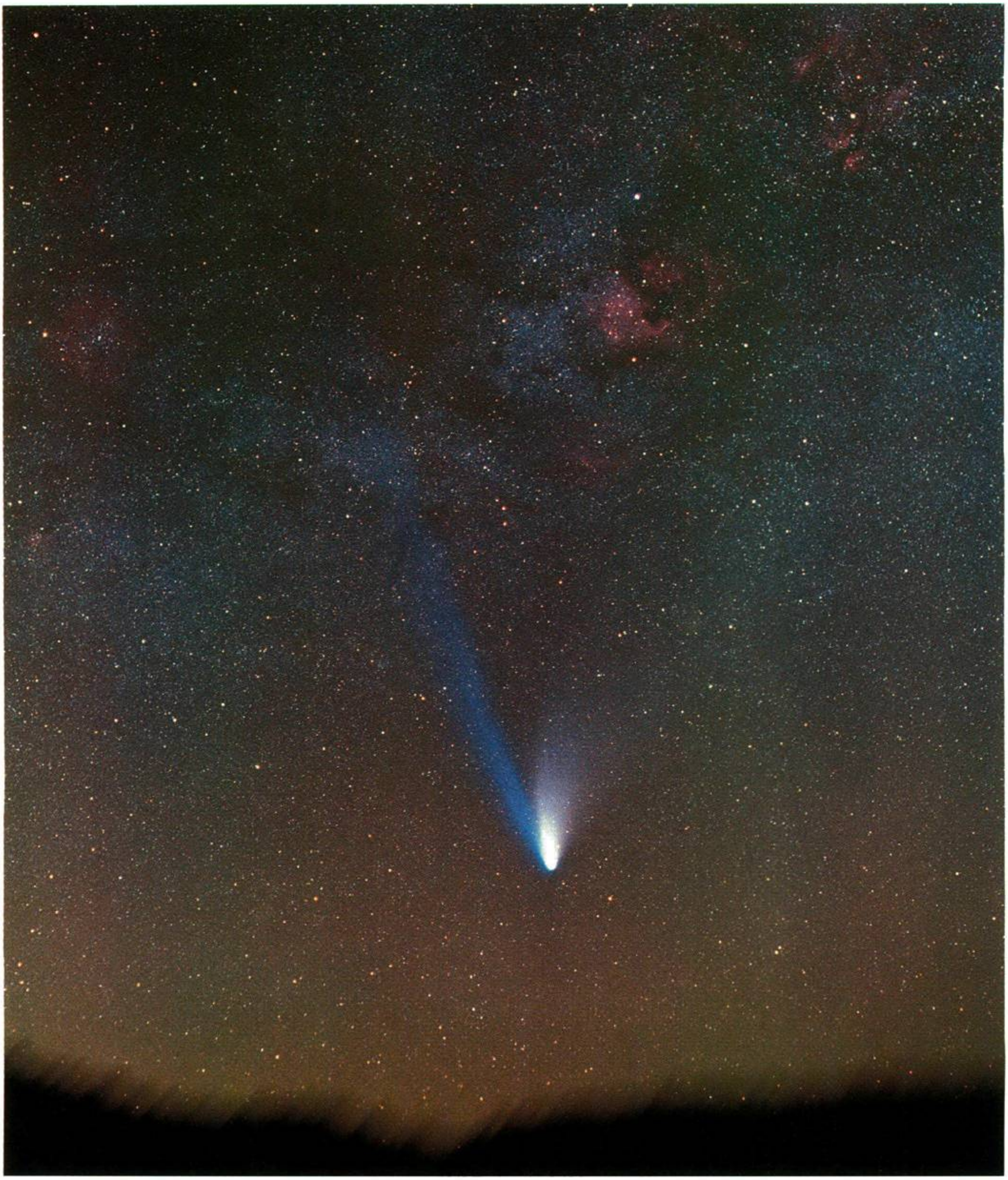
(10-inch f/4.5 refractor at 127x on March 16, 1997)



Hale-Bopp Reflected in a Mountain Pond

JERRY SCHAD

(85mm lens at f/1.7, Kodak Ektachrome P1600 film pushed to ISO 3200, 35-second exposure taken on March 17, 1997)



Hale-Bopp Floats below the North America Nebula

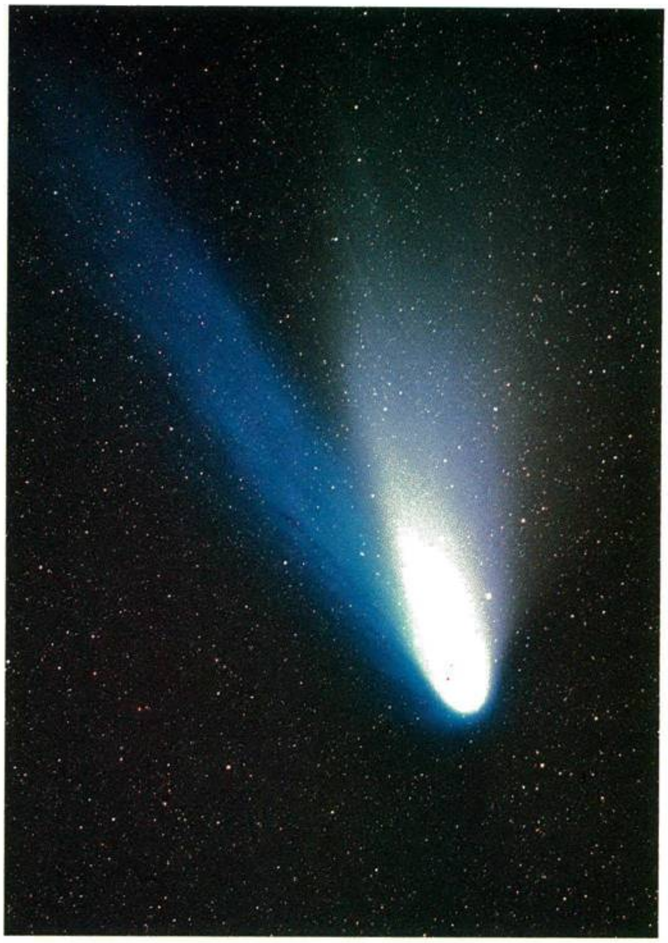
JOHN A. VOLK

(105mm lens at f/6, 6x7cm camera, Kodak PMZ 1000 film, 8-minute exposure taken on March 9, 1997)

Hale-Bopp in Winter Twilight

DAVE HARRIS

(100mm lens at f/2.8, medium-format camera, Fuji Sensia 400 film, 45-second exposure taken on March 18, 1997)



Hale-Bopp's Blue Gas Tail and White Dust Tail

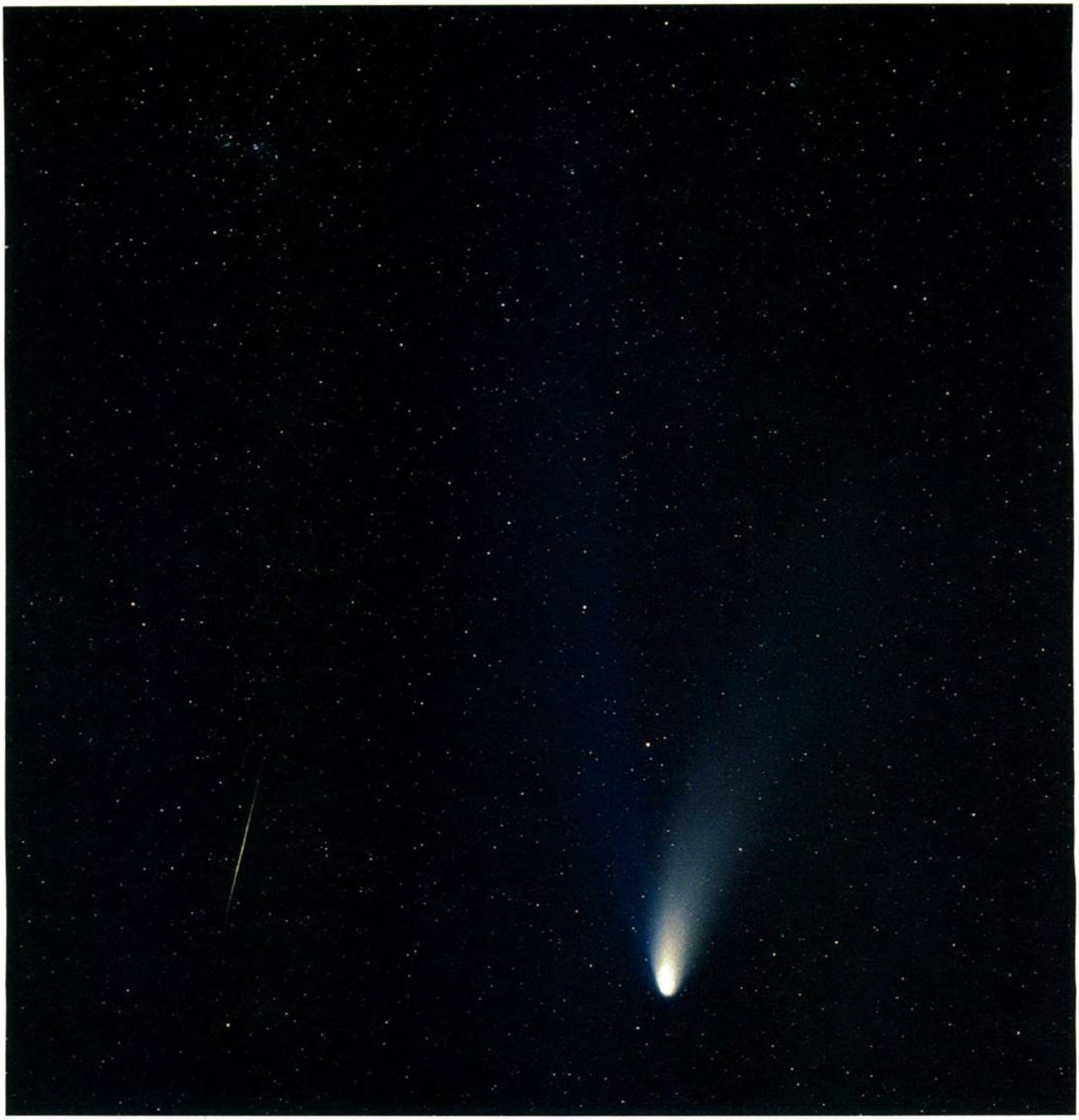
JOHN A. VOLK

(4-inch f/6 refractor, 6x7cm camera, Kodak PMZ 1000 film, 6-minute exposure taken on March 9, 1997)

Predawn Hale-Bopp over a Pennsylvania Homestead

KENT BLACKWELL

(50mm lens at f/2, Fujicolor Super G+ 800 film, 25-second exposure taken on March 17, 1997)



Scaling Hale-Bopp's Cosmos

CHRIS MADELEY

(150mm lens at f/4, medium format camera, Kodak Panther 400 film, 16-minute exposure taken on March 29, 1997)

Comet Hale-Bopp shines across 125 million miles of interplanetary space against the backdrop of Andromeda and Perseus. Most of the stars are within 500 light-years of Earth, members of the same spiral arm that harbors our sun. Snugged into the upper left-hand corner of this photo are open star clusters NGC 884 and NGC 869, the Double Cluster in Perseus. Both are about 7,400 light-years away in the next spiral arm out from the sun's. Closer to home, a meteor plunges into oblivion with a flash of light about 50 miles above Earth's surface.

TELE VUE DEALERS

ARIZONA

The Astronomy Shoppe
1/2 Mile South of Bell Rd.
15836 N. Cave Creek Rd.
Phoenix, AZ 85032
YOUR LOCAL TELE VUE® DEALER
602-971-3170

Quality **Tele Vue®** Products
Stellar-Vision & Astronomy Shop
• New and Used Equipment • Sales and Service
1835 S. Alvernon #206 • Tucson, AZ 85711
(520) 571-0877
SINCE 1986
http://www.theriver.com/stellar_vision

CALIFORNIA

Tele Vue® Optics Specialists!
OPT Oceanside Photo & Telescope
1024 Mission Ave.,
Oceanside, CA 92054
800-483-6287 • email: opt@cts.com
(619) 722-3348 • http://www.optcorp.com

Complete Line of Quality
Tele Vue® Products
Scope City
World's Largest Centers - EXPERT HELP.
Mail order: P.O. Box 440, Simi Valley, CA 93065
TEL: (805) 522-6670 • Fax: (805) 582-0292
Catalog Package $7 (refundable with purchase). Free price list.

SIMI VALLEY,CA
679 Easy St.
Simi Valley, CA 93065
TEL:(805) 522-6646

SHERMAN OAKS,CA
14324 Ventura Blvd.
TEL:(818) 789-5805

COSTA MESA,CA
COSTA MESA, CA
3033 S. Bristol
TEL:(714) 957-6900

SAN DIEGO,CA
4766 Clairemont
Mesa Blvd.
TEL:(619) 277-6686

BUY • SELL • TRADE • SERVICE

Tele Vue® PANOPTIC™

68° Widest Field

15mm - 1-1/4"	$215
19mm - 1-1/4"	$245
22mm - 1-1/4"/2"	$285
27mm - 2"	$335
35mm - 2"	$365

1-800-767-9576

LUMICON
2111 Research Dr. #4-5
Livermore, CA 94550

MASSACHUSETTS

Genesis-sdf
Free quik point with pronto

If you're looking for New England's oldest, most experienced Tele Vue® dealer, you've found it.

- Most Tele Vue scopes, accessories, and eyepieces in stock
- Antique optics
- Used equipment
- Trade-ins
- 78 years of experience
- Boston showroom
- Helpful staff
- Low prices
- Rental equipment
- Order by mail or phone

F. C. Meichsner Co., Inc.
182 Lincoln Street, Boston, MA 02111
(800) 321-VIEW! (8439)

VISIT THE Tele Vue® WEB SITE
http://www.televue.com

GEORGIA

Atlanta's Leading **Tele Vue®** Telescope and Binocular Dealer. We Ship Practically Anywhere.
Camera Bug Ltd.
1799 Briarcliff Rd. • Atlanta, GA 30306
(404) 873-4513 • FAX (404) 873-3925
ORDERS ONLY 800-545-8509
cam_bug@msn.com

NEW JERSEY

We carry Tele Vue®
DOVER PHOTO SUPPLY
26 E. Blackwell St. - Dover, NJ 07801
Call for more information.
Tele: (201) 366-0994
Fax: (201) 366-0990
Established 1895

Full Line Tele Vue® Dealer
BERGEN COUNTY CAMERA
270 Westwood Ave.
Westwood, NJ 07675
Ph: (201) 664-4113 · Fax: (201) 664-0067

NORTH CAROLINA

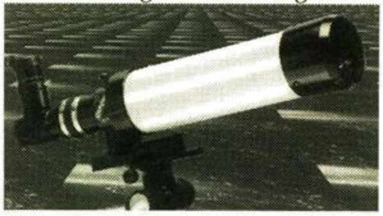
Your quality **Tele Vue®** dealer in North Carolina
CC Sales / Camera Corner
Phone: 1-800-868-2462
Fax: (910) 222-8011
2273 S. Church St., Burlington, NC 27215
email:lroane@camcor.com

TEXAS

Analytical Scientific™
"The Source For All Your Astronomy Needs"
A whole new way to explore the Universe
AUTHORIZED TELE-VUE DEALER
11049 Bandera Rd., San Antonio, TX 78250
Info: (210) 684-7373 • fax: (210) 520-3344
Toll Free Order Line: 1-800-701-STAR (7827)
http://www.rahul.net/astro-mall

NEW YORK

ADORAMA
42 West 18th Street • New York, NY 10011
Tele Vue®
Full line of Tele Vue eyepieces and telescopes in stock and on display including the new Ranger



Our sales staff, dedicated to astronomy can help with your purchase

ORDER TOLL FREE 800-723-6726
ORDERS & INFO 212-647-9800
FAX # 212-929-9013

PENNSYLVANIA

AMATEUR ASTRONOMERS...
THE NEW TELE VUE® - GENESIS SDF SKY TOUR PACKAGES ARE NOW AVAILABLE
SPECIAL PACKAGE INCLUDES:
Genesis SDF, Gibralter Mount, Factory Installed Sky Tour, Star Beam, Air Chair, 7 Nagler, 2x Barlow. PLUS Pocono exclusively also gives you a 4.8 Nagler and Thousand Oaks Solar Filter. Call or stop in for details.

★ See Solar Prominences every Saturday with the Genesis SDF/Solar Kit and T-Scanner at our showroom.
★ Tele Vue® Plossls sale priced from $70.00.

Send SASE for free price list/$6.00 for complete catalog package

✹ We ship everywhere ✹
See our ad on pages 36 & 37
Pocono Mountain Optics
Corner of Route 307 & 502
104 NP 502 Plaza
Moscow, PA 18444
Orders Only (800) 569-4323
Info. (717) 842-1500 (9am-9pm)
Fax (717) 842-8364 (24 hrs.)
Showroom hrs: 10-5 Mon. – Sat.
pocmtnop@prolog.net

WASHINGTON

Captain's Nautical Supplies
-EST. 1897-
Complete line of **Tele Vue®** telescopes and eyepieces.
Expert optical instrument repair.
2500 15th Avenue W.
(1 mile South of the Ballard Bridge)
Seattle, WA 98119
Phone: (206) 283-7242 • 1-800-448-2278
FAX: (206) 281-4921

WISCONSIN

EAGLE OPTICS®
Complete selection of
Tele Vue
eyepieces & telescopes
shipping nationwide
716 S. Whitney Way
Madison, WI 53711
(800) 289-1132 FAX (608) 271-4406
http://www.eagleoptics.com

TELE VUE...TOPS IN THE FIELD

NAGLER

82° — "Space out" with Al

The "spacewalk" eyepiece! Patented & tested to be the best! Fully multi-coated, eyeguards. 20, 16, 13, 12, 9, 7, 4.8mm

NEW PANOPTIC

Introducing the 19mm

The 68° Panoptic family welcomes the arrival of its new 7oz, 1¼" 19mm. A "killer" with Bino Vue! 35, 27, 22, 19 & 15mm

PLÖSSL

50° -Mr. P Would be Proud

Preferred Plössl in S&T comparison review. Fully multi-coated, patented Nagler design. 55, 40, 32, 25, 20, 15, 11, 8mm

PARACORR

How to Figure a Newton

Paracorr corrects coma and flattens the field of "DobNewts," increases diffraction limited field area by 36 times and slips into a 2" focuser like a Barlow! Essential for f/4 — f/5 scopes. See perfection emerge.

BINO VUE

Cyclops Need Not Apply

Bino Vue features in-line viewing for terrestrial and astronomical observing, no focus shift during inter-ocular adjustment, large, multi-coated prisms and Tele Vue quality control. Dramatically transforms any scope!

BARLOWS

No Fat, All Muscle Power

Nagler designed for optimum performance. NO aberrations, just magnification! 2x & 3x (1¼"), 2x (2") with captive screw & parfocal 1¼" eyepiece adapter. Fully multi-coated and threaded for filters.

RICH FIELD KIT

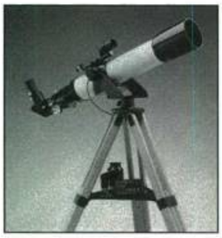
SCT owners—Get Rich Quick!

No gimmicks. Maintain the optical integrity of your scope and increase its field area by 3 times with our Rich Field Kit. The kit includes adapters, 2" diagonal and 55mm Plössl for maximum true field. Use the 35mm Pan. & 20mm N2 too!

GIBRALTAR/SKY TOUR

What a trip!

Rock-solid wood tripod with alt-az head. Sky Tour computer available for finding and identifying 2000 objects selected by author Tom Lorenzin. Great with all Tele Vue scopes. Full object listing included.



FINDER

Didn't Know She's Missing

Star-hop across the sky with Starbeam and Qwik-Point "red-dot" finders. Starbeam features a large 40mm lens, variable brightness, elegant design and all metal construction. Qwik-Point offers day & variable night brightness, light weight & exceptional value.

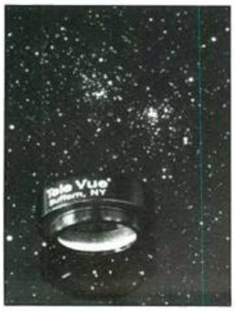
UP-SWING

How to Swing on a Star

Up-Swing threads onto any standard camera tripod to provide it with smooth and balanced vertical positioning—exactly what camera tripods lack for astronomical observing. The modified Panoramic head accepts any Tele Vue telescope 4" or smaller.

FIELD FLATTENER

Flatten Your Pronto/Ranger



Just place between camera adapter and T-ring for knock-out punchy starfield photos. The 480mm focal length extends to 520mm at f/7.4.

Tele Vue products are designed, manufactured and tested to be fully appreciated where it counts — in the field.

Tele Vue®

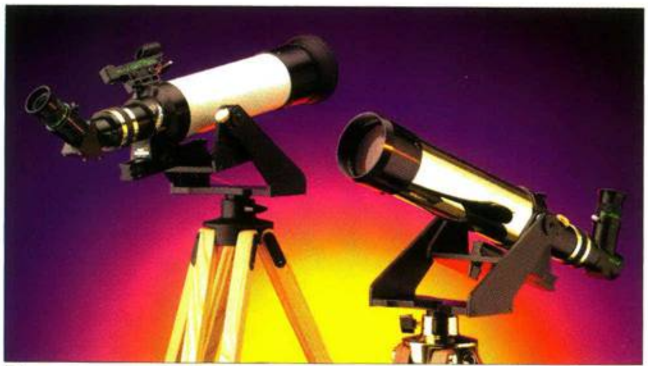
Visit the Tele Vue web site at http://www.televue.com Product flyer free or send $3 for full-line literature.
Tele Vue Optics, Dept. A, 100 Route 59, Suffern, NY 10901. (914) 357-9522.

TELE VUE RANGER & PRONTO

Heads or Tails...

Pronto photograph of Comet Hyakutake, by William Yang of Taiwan

You Win.
Get
High Power
and Wide Field
with Ranger
& Pronto.



Ranger

	Ranger	Pronto
Objective:	2-element, E.D.	Same
Power Range:	12x - over 200x	9x - over 200x
Visual Field:	3.3°	5.5°
Photo Field:	5.2° 35mm film diag.	Same
Aperture:	70mm	Same
Focal Length:	480mm	Same
Focal Ratio:	f/6.8	Same
Focus Type:	1¼", 2 Stage with Helical	2" Rack & Pinion
Dew Shield:	Available	Captive, Sliding
Mounting:	¼-20 Balance Bar	¼-20 Mount Ring
Carry Bag:	Available	Custom Padded
Choices:	1¼" Mirror Diag., 1¼" 45°, or Porro Prisms	2" or 1¼" Mirror Diags., 1¼" 45°, or Porro Prisms
Accessories:	All 1¼" Tele Vue eyepieces 2x Barlow optimum All Tele Vue Mounts Qwik-Point 35mm Camera Adapter Padded Shoulder Bag Padded Fitted Bag Rubber Lens Shade	All Tele Vue eyepieces All Tele Vue Barlows All Tele Vue Mounts Starbeam or Qwik-Point 35mm Camera Adapter Piggy-Cam

Pronto

- *I wanted an extremely portable instrument of superb quality. I consider Pronto to be the Questar of refractors. It is of superb manufacture and the views are razor sharp with beautiful contrast. — J.B. AZ*
- *I really like the RFT/diffraction limited design. And, Pronto was within budget. I'm very pleased! Not only could I see Io's shadow clearly transit Jupiter (at 95x), but I could trace Io itself across the planet's darker limb - even in front of a lighter band of clouds. Thanks again. — B.O. IL*
- *I'm impressed. Ranger performs like a larger aperture telescope. A star test revealed perfect diffraction patterns. — A.G. TX*
- *Great optics, great machining. Spectacular low-power views; seems much larger than 70mm; lots of detail on high power Jupiter. — P.R. NY*
- *I needed a grab and go scope with guts. Ranger is an astounding instrument! My 8" can't keep up with this rascal — N.R. NE*
- *I need portability; to carry on flights - (airline crew). Pronto is a beautiful scope; my first look at Jupiter and Saturn convinced me I had made the right choice. Thank You. — P.H. Hong Kong*

Product flyer free or send $3 for full-line literature.
Visit the Tele Vue web site at http://www.televue.com
Tele Vue Optics, Dept. A, 100 Route 59, Suffern, NY 10901. (914) 357-9522.

Tele Vue®

CELESTRON Tools *for* Astronomy

ULTIMA® BINOCULARS. Shown below is the 8x56 model. Similar in appearance is a new 9 x 63 model. **The Ultima® Series** is sleek in appearance with superb image quality rivaling the best European binoculars. You will not find better binoculars at even twice the price. Fully multi-coated, long eye relief and a deluxe soft case. BAK-4 prisms, excellent depth of field and extremely lightweight.

GIANT BINOCULARS. Two 20x80 models are offered. The **Deluxe** model has structural reinforcement of the main body for added stability. It also includes a built-in super rigid photo tripod adapter and includes a deluxe hard case. The **Standard** model is more economical but the performance is superb. Both models feature BAK-4 prisms, 3.5° field of view and have multi-coatings. **Celestron** offers a full line of binoculars – *ask for details!*

STAR POINTER. A simple electronic finderscope with unit magnification for easy telescope pointing. The aerial image red dot has a variable brightness control. Professional looking.

LENS PEN. A new optical lens cleaning technology for small glass surfaces. Use for binoculars, eyepieces, lenses, eyeglasses, etc. A retractable brush and a non-liquid cleaning pad.

RICH FIELD 80 SCOPE. A large 80mm multi-purpose scope.

The optics are fully multi-coated to ensure high contrast levels and excellent resolution. The lens system contains an air-spaced doublet.

Bird watchers will appreciate the excellent performance in low light conditions as well as a near focus of ten feet.

Photographers will like the fast optical system – 400mm f/5. The weight is only 35 oz. Focusing is done with a fast, smooth rack and pinion focuser – 1.25". The length of the scope is 13.5".

The large aperture allows you to enjoy limited astronomical viewing of the Moon, planets, brighter nebulae and clusters. A built-in photo tripod adapter allows easy mounting to larger astronomical telescopes where the **Rich Field 80 Scope** becomes a piggyback camera lens, imaging lens or guidescope.

The aluminum tube is protected by rubberized cells at the front and back.

Trail Vision
Night Vision

FLASHLIGHTS. Celestron offers four models of flashlights for astronomy at varying price levels – from the disposable **Red Astro Lite,** to the **LED Flashlight,** to the premium adjustable **LED's Night Vison** and **Trail Vision.**

ASTRO MASTER®. New models are available – **Junior** and **Advanced** with new features and lower prices! Computerize your telescope easily.

CELESTRON EYEPIECES and BARLOW LENSES

PLÖSSL EYEPIECES – Premium quality 1.25" eyepieces at affordable prices. All units are multi-coated for enhanced contrast. Optically, they're among the best designed and best corrected eyepieces available. Available in 8 focal lengths – 6.3mm, 7.5mm, 10mm, 12.5mm, 17mm, 26mm, 32mm and 40mm.

A **Deluxe Zoom Eyepiece** 6.5 to 18mm – 1.25" was recently designed and has become the finest zoom ever offered for medium to high powered observing. This eyepiece is multi-coated and extremely lightweight (5 oz.).

LV EYEPIECES – These 1.25" eyepieces are a new generation using the rare earth glass – lanthanum – as one of the field lenses to help hold aberrations to an absolute minimum. All focal lengths have a 20mm eye relief – just imagine using a 2.5mm at high power on a telescope with eye relief of 20mm! Features fully multi-coated lenses and a body and eyecup made of soft rubber. Available in focal lengths of 2.5mm, 4mm, 5mm, 6mm, 9mm, 10mm and 15mm.

The standard quality achromatic 2x **Barlow Lens** is fully coated and of the short design (2.8") and weighs just 4 oz.

ULTIMA® EYEPIECES – Celestron's top of the line 1.25" eyepieces which use a hybrid design of 4 to 7 elements. Features long eye relief and a wide field. Full multi-coating on each air-to-glass surface enhances contrast levels. Computer designed to keep the following aberrations to an absolute minimum: spherical, coma, astigmatism, distortion, color, field curvature and spherical of the exit pupil. Inside and all lens edges are blackened to keep out reflected light. The outside is flat black with rubber grips. Included are rubber eyecups for comfort and to keep out extraneous light. Focal lengths of 5, 7.5, 12.5, 18, 24, 30, 35 and 42mm.

The **Ultima Series Barlow** (2x – 1.25") is an air-spaced, three-element apochromatic design with a 27mm clear aperture. It is a super high quality design and fully multi-coated. It is amazingly short (2.75") and weighs just 5 oz.

CELESTRON® *For more detailed information on these products, contact a Celestron dealer or Celestron.*

Celestron International • 2835 Columbia Street, Torrance, CA 90503 • (310) 328-9560 • FAX (310) 212-5835